The Electrical Experimenter

BALL LIGHTNING

See page 468

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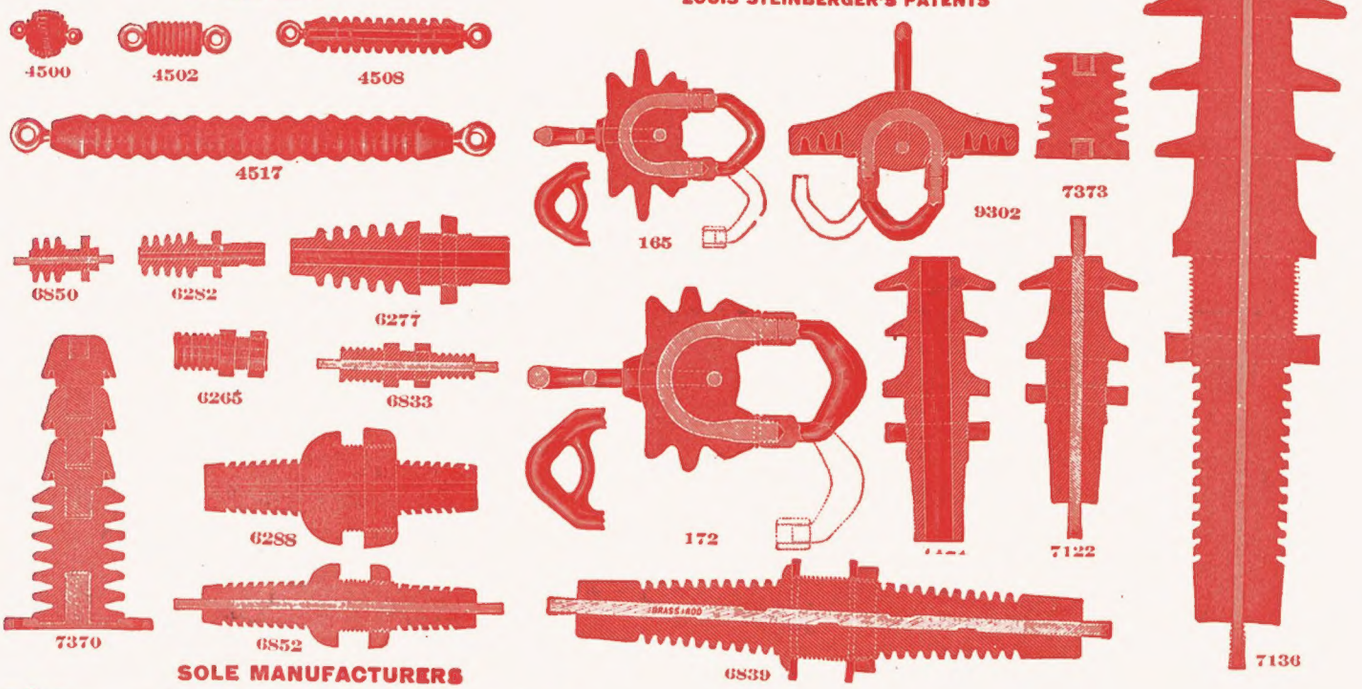

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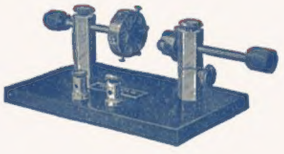

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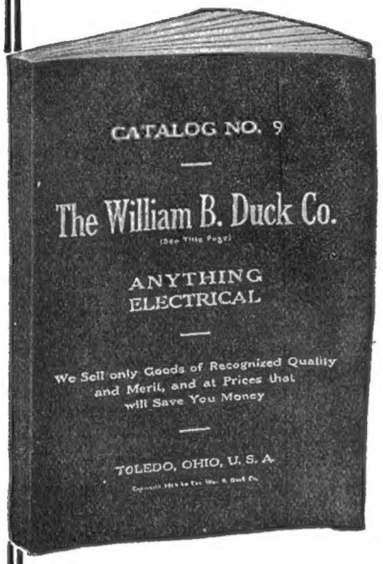
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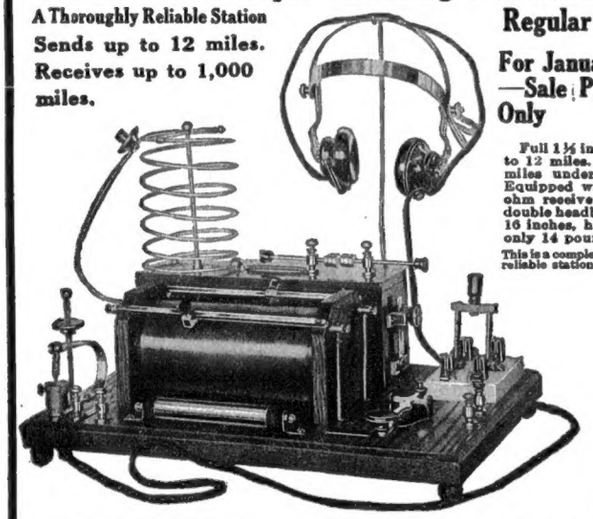

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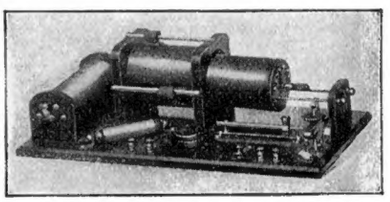

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F. B. Chambers & Co., Wireless Engineers, 2046 Arch St., Philadelphia, Pa., write:

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"Everyone was more than surprised at the results, and believe us when we say—that it surely was some amplifying; *and there is nothing that can anywhere near touch the Multi-Audi-Fone.*"

Jeffries-Young Antenna Co., of Atlantic City, N. J., write:

"The Amplifier and Multum in Parvo Set received from you are giving wonderful results, and come up to the mark on every claim made. The Arlington Signals before audible with the Phones 12 inches away, can now be copied in nearly every room in our house, on St. Charles Place, where our winter station is located."

W. O. Horner, of Cleveland, Tennessee, says:

"I have been trying your Multi-Audi-Fone out as an Amplifier. . . . I was more than surprised at its sensitiveness. . . . It is certainly wonderful."

Again he writes: "Yours of the 28th at hand. I use a Triple Valve Station of highest class and thought I had the best on the market but when I hooked your Multi-Audi-Fone to the third Audion I was astonished at its Amplification.

"I laid your Phones on the table and walked 125 feet to the rear of my store and copied Arlington and Key West at 9:30 P. M. Many 600 Meter stations I also copied at this same distance. *I also hooked your Multi-Audi-Fone to a single Audion and signals were much louder than all three of my Amplifiers.*"

S. Kruse, of Halstead, Kansas, writes: "Multum in Parvo is a wonder."

M. B. Schwartz, of Brooklyn, N. Y., writes:

"With regard to results obtained on connecting the Multi-Audi-Fone in my Radio receiving set as an Amplifier, I am glad to say that I was astonished by the roaring and whistling of myriads of stations, near and far, many of which I never heard before; the small amateur stations coming in so loud that they were heard all over the room—it was like opening up a new region, fertile with activity and life, heretofore unknown. It may also probably be of interest to you to know that I heard the SS. Brazos every evening from the time she left San Juan, P. R., Oct. 20, until she reached New York, during the run she came in with remarkable audibility.

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F. S. Hammond, of St. Marys, Pa., writes:

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The Electrical Experimenter

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The Collapse of the Submarine War

IN our July issue we stated editorially: "In analyzing past and present means of warfare, we invariably find that it is possible to combat weapon by weapon." After a brief statement showing how at that time the submarine could not be combated with existing means, we continued: "Our imagination need not be stretched unduly to presume that electricity will, in the not too distant future, be employed to render the submarine harmless."

Within less than six months this prophecy has come true, as was to be expected. When Germany declared her historic submarine war against England in February, 1915, things looked indeed black for the British Admiralty as well as for British shippers. Germany, as usual, struck swiftly and with terrifying results. In February her submarines sank 8 vessels. In March, 32 vessels were sent to the bottom, while in April, 21 fell prey to this modern electric monster of the deep.

Thus, from February till August 30 altogether, 197 ships had been sunk at various points around the British Isles. Then suddenly, as if by magic, the sinking of ships by submarines stopped. Indeed, during the entire period from September 1, 1915, until December 1, 1915, only 33 ships had been sunk by German submarines. (The last figure also includes ships sunk by the Austrians in the Mediterranean, as well as small fishing craft.)

Although we know that a great many German submarines were sunk by England and France during the submarine war, it is certain that Germany has more undersea craft to-day than at the start, for submarines are relatively cheap, and can be built quickly if necessary. Nevertheless, as each week passes, fewer and fewer ships are reported sunk, and the day is not far off when German submarines will cease to exist altogether as far as England or France are concerned.

Once more science—and particularly electricity—has triumphed; a silent, but nevertheless a remarkable triumph of mind over matter. War is no longer man against man, brain against brain; it is machine against machine, science against science. England and France have a number of efficient schemes to-day with which they combat the submarine with electricity, either directly or indirectly, and although this particular branch of science is less than six months old, the results have been more than encouraging to these countries. One of the schemes in use, said to give entire satisfaction, is described in this issue of the *Electrical Experimenter*. Various other schemes using super-sensitive microphones under water have been reported from time to time, and we are informed that England has lately equipped all her war vessels with an electrical device which not only detects submarines, but their exact location as well. This device, so far, has been carefully kept secret, as is only natural.

Thus the battleship has come into its own again, instead of going to the scrap heap, as was feared in some quarters when the submarine war was at its height. The submarine, on the other hand, has been relegated to its former station, that of a defensive weapon, for which it is admirably suited, not for offensive purposes.

While Austria has been busy of late sinking a few ships in the Mediterranean, we can safely predict, that as soon as France and Italy have equipped their shores and their ships in the same manner as has been done in the Channel and in the North Sea, these submarines also will be reduced to impotence.

H. GERNSBACK.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. *A green wrapper indicates expiration.*

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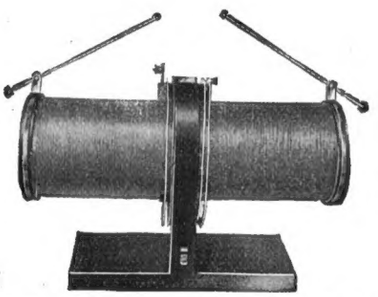

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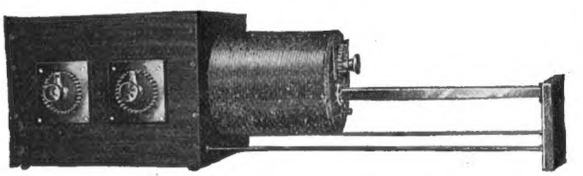

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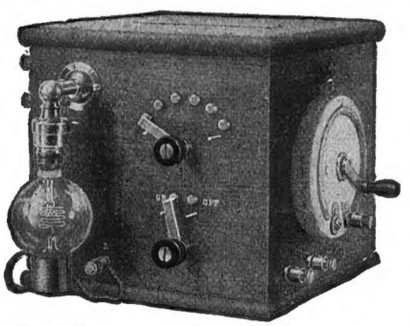

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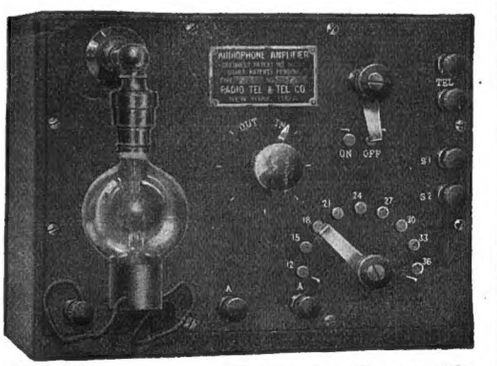

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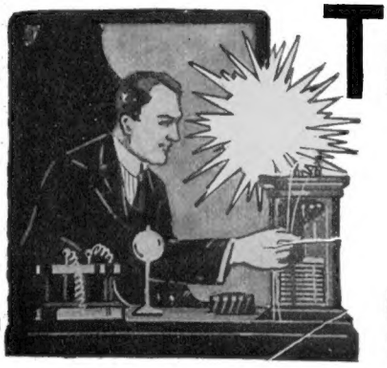


THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. III. Whole No. 33 JANUARY, 1916 Number 9

Electrical Device Detects Submarines 20 Miles Away

THE long sought for solution of the submarine detection problem has apparently arrived in the form of a specially tuned microphonic device which is placed below the surface of the water along the coast line, and in the following paragraphs the general principles utilized in exactly detecting and locating the position of a submarine, when it is totally submerged, are explained.

The American electrical engineer, William Dubilier, recently returned from France, has developed this "submarine detector" to a high degree, and in his research work he had the co-operation of Prof. Tissot, the noted French scientist. A properly designed microphone or sound-operated instrument, which will translate sound energy into a corresponding electrical current, forms the nucleus of this remarkable invention which, it is said, has aided in doing away with a formidable number of German "U" boats around the French and English coasts. When sound waves impinge against the diaphragm of a microphone (which corresponds in general to that fitted on an ordinary telephone apparatus with which we are all familiar), it causes a variation of the inherent electrical resistance of this instrument, owing to the different pressures exerted against a number of small carbon balls, placed in a cup back of the diaphragm.

Contrary to the general opinion which might prevail in such a case, it is not the sound of the propellers or the engines of the submarine that are heard best, according to Mr. Dubilier, but the high humming note produced by the electrical motors utilized in propelling the submarine when submerged beneath the surface of the sea. Thus a most important point is gained, for if it were the former which emitted the sound waves used for the successful operation of this latest scientific device, the possibilities are that very little success would be attained, as the engines are not used except when cruising on the surface. It has been found that if the microphone is placed in a properly tuned resonance chamber, located about 20 feet below the surface of the water at the shore testing station, this particular humming note reverberated by the entire metallic shell of the submarine, can be selected and then intensified by means of suitable amplifiers, such as the well-known Audion type, developed by Dr. Lee de Forest.

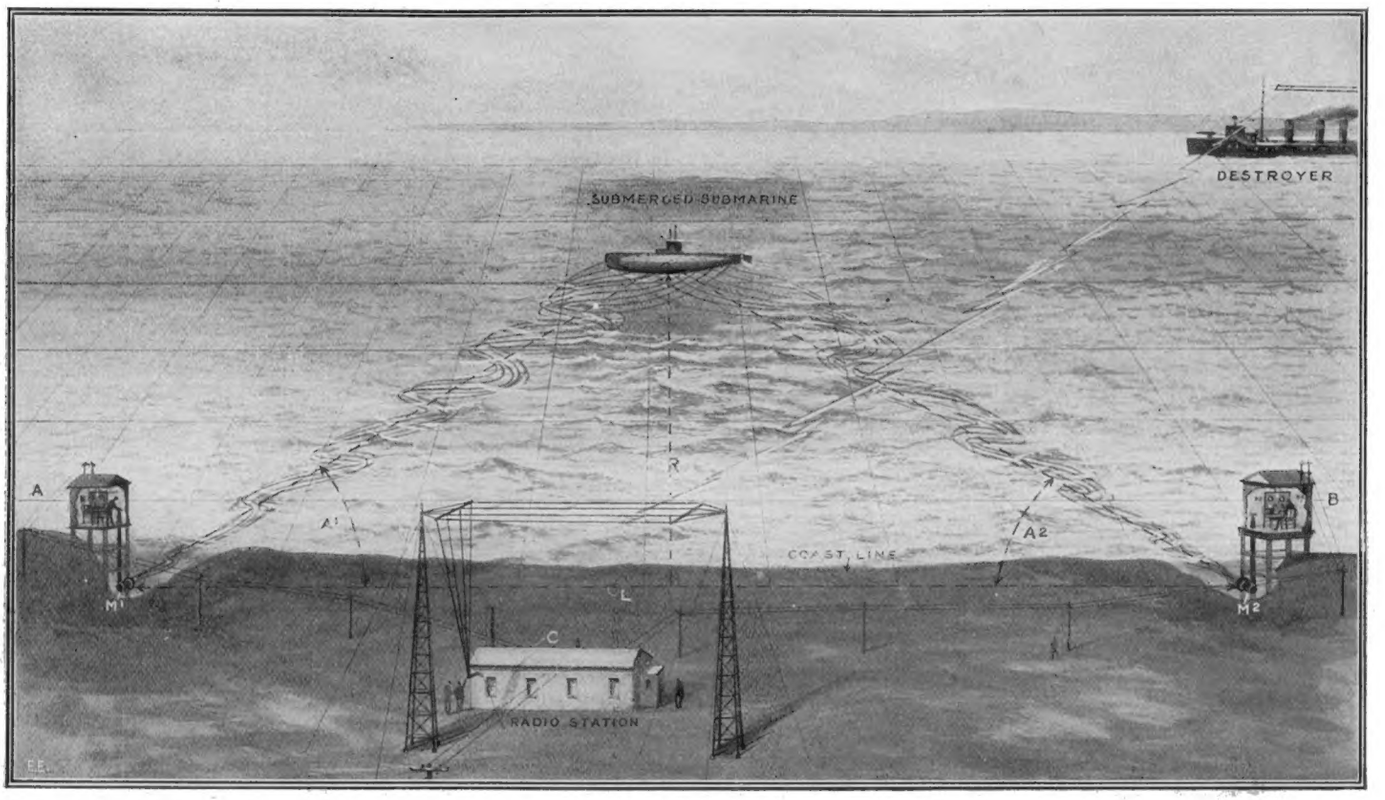


Fig. 1. Diagram Showing How Science Now Locates Submarines, Even When Submerged, by Means of Sensitive Electrical Ears That Pick Up the Peculiar Note They Emit.

This particular note, so effective in the successful operation of Mr. Dubilier's instrument, has been found to have a frequency period of about 750 cycles per second. The illustration herewith shows the inventor of this clever scheme for detecting submarines, holding one of the super-sensitive microphones, and, also Fig. 2, shows a detail photograph of the microphone proper. Several methods for filtering out the extraneous sound waves trans

mitted by passing steamers and the like were successively tried out, but the best method of all was ascertained to be the one embodying the use of resonance tubes, incorporated in the shell containing the submerged microphone. In this way it was found possible to closely tune the micro-

William Dubilier, the American Engineer, Has Perfected for the Allies a Successful Submarine Detector. He is Here Observed Holding the Super-Sensitive Microphone Used.

phone chamber, so that it would respond to the vibrations of the order above mentioned only, or to any desired harmonic of this frequency. These have proven very successful and are now being used by all submarine detecting stations located on the English and French coasts.

The resonance chamber, tunable to any desired musical note frequency, and in which the microphone proper is placed, is shown in Fig. 3. This consists of a stout outer steel chamber A, in front of which is placed a metal diaphragm B. Even at a very little submerged depth the water pressure against the diaphragm is severe indeed, and to counteract this, compressed air is fed into the chamber A, to offset this water pressure on the exterior casing. The diaphragm B is rigidly supported in the heavy outer chamber, which is pivotly mounted on the directing rod, as observed. There

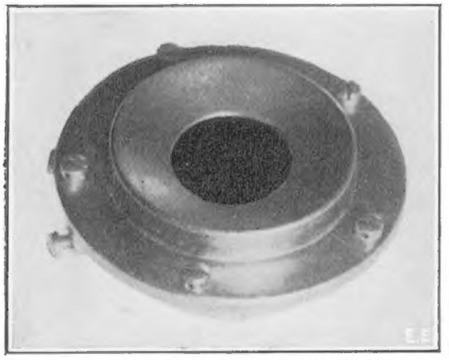


Fig. 2. Appearance of Sound Detecting Microphone Which, Submerged in the Waters Along the Shore, Indicates the Presence of Undersea Craft.

is carefully fastened to this a steel resonance tube, which consists of two distinct tubes, one sliding within the other so that it may be adjusted for any note desired. Both of these tubes have diaphragms in them, as perceived from the sketch, and in the same way as an organ pipe vibrates at different frequencies, depending upon its length; so this resonance tube vibrates to some particular note, depending upon how far apart the diaphragms in same are situated. Hence this remarkable device will not only respond to one particular note accurately, but it will, owing to the phenomenon of resonance, respond with maximum efficiency to that note, and in this way the microphone is affected in the most powerful manner possible for any given signal or sound wave. Flexible and heavily insulated wires lead up from the microphone to the operator in the detecting station, located on the ground above. In this station is located the Audion amplifier apparatus, as well as the telephonic and telegraphic instruments for communication with the wireless station and with the second detection station.

The large illustration, Fig. 1, here portrayed, gives a general layout of the scheme, as it is applied in practice. As observed, a submerged submarine is seen progressing from right to left across the view. Of course, if the submarine should stop its propellers and likewise its motors or engines, and submerge to the bed of the ocean, or bay, no sound would be heard. But, on the other hand, it could not very well start up the propellers and get away without being at once detected by the observers stationed at the various shore stations. The underlying principle governing the detection and accurate location of a submerged submarine is based on the same methods as used in modern long distance gun sighting. Let us assume two detecting stations at A and B, respectively, and at a certain known distance apart, as indicated by the line L. Also that these stations are telegraphically or telephonically in communication with a wireless station C, as well as with each other. Now when the operator located at station B rotates his submerged microphone by means of a suitable shaft and gear arrangement, etc., until the incoming submarine note is heard loudest (or, as a matter of fact, as soon as he hears the note at all), he immediately notifies the operator at station A of this fact. Operator A then endeavors to tune in the submarine's note to a maximum value, and when both A and B have their instruments so set that the note is heard at maximum strength, then the angles A_1 and A_2 are definitely known from the calibrated dials fitted to the microphone controlling shafts. It is now a simple matter to make the calculation (usually by means of a slide rule, specially constructed), to find the exact range or distance R, between the submarine and the base line L.

Also to facilitate matters in this respect, the water is definitely laid out in squares, as indicated by the lines in the drawing. These lines, of course, are only imaginary, but they are exactly plotted on the maps used by the military authorities in charge. All these squares are numbered and, therefore, it is an easy matter to give explicit directions through the wireless station C, to a waiting torpedo boat destroyer so that this terror of the submarines may proceed quickly to the exact square in which the submarine is to be found. The under-water craft may be moving into a second or third square from that first communicated to the commander of the torpedo boat destroyer, but that is a small matter and is checked up constantly by A and B and then transmitted to the commander through the wireless station; thus keeping him acquainted with the definite whereabouts of the under-sea boat every few minutes.

In most cases the submarine, after a short while, comes to the surface to make observations, as otherwise it is running blind so far as events above the surface of the water are concerned. In a remarkable number of instances this method has worked, it is said, with wonderful success, and as soon as the submarine came to the surface, it took but a few moments to either destroy or capture it by means of the destroyer, which was on the spot at the instant the submarine shoved its periscope above the surface of the sea.

So we see that while the submarine has been developed to a wonderful degree, in so far as range and other features are concerned, there has been devised by scientists a method to counteract their efficiency. In less time than it takes to tell, a torpedo boat destroyer may be despatched to the exact spot where the submarine is so peacefully pursuing its way and, as it supposes, unseen and unknown.

Or, again, it is possible to send an aeroplane to the scene, equipped with powerful explosive bombs. On the latest type of these aerial bombs, designed for the destruction of submarines when under water, there is provided fluted tails which cause them to go straight down into the water for a considerable distance without deviating from the point originally aimed at. The aeroplane has proven one of the best detectors of submarines when it happens to be known where the submarine is located. Although not generally known, it has been definitely proven that the observer in the aeroplane flying at a considerable distance above the water, and regardless

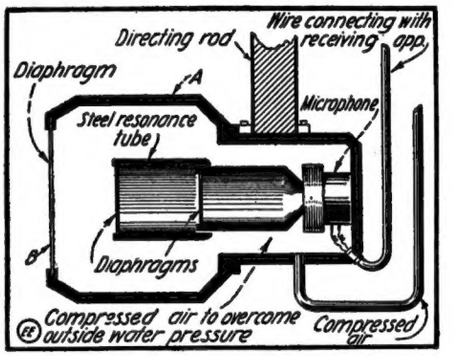


Fig. 3. Details of Specially Contrived "Resonance Tubes" and Microphone Arranged in Stout Water-proof Shell.

of the wave formation on the surface, can detect accurately the presence of a submarine even though submerged 75 to 100 feet below the surface.

It may be said in conclusion that these marvelous submarine detectors have not proven satisfactory for use on ship-board, but this point will probably be overcome in the near future. This is accounted for by the noise and severe vibration encountered on the vessel itself on which such apparatus has been installed. However, it has proven a Godsend to those responsible for the protection of the water adjacent to the English and French coasts, and it is hoped that the United States Government will not be dilatory in recognizing the merits of this most ingenious device which has been the goal of many hard-working engineers and scientists in the United States and abroad for a number of years.

Wellesley College girls will eat electrically prepared food in their new central dormitory. The new wing is equipped with a special three-oven 12-foot range and a bake oven with a capacity of 90 one-pound loaves. The equipment will serve 250 students and help.

New Instrument Eliminates Fog Peril

NAVIGATORS before long may find fog robbed of its terrors through a device invented by Dr. A. G. Webster, of Clark University, Worcester, Mass., for showing the direction of signals, which he demonstrated recently at the final autumn session of the National Academy of Sciences held in the American Museum of Natural History at New York. The apparatus, which he calls a "phonometer," translates the intensity of sound into terms of light or intensified sound, as by ringing a bell, so that, as the inventor expressed it, the deaf may see and the blind may hear it.

Impressed with the loss of the steamship "Empress of Ireland" in 1914, he went to Father Point, on the St. Lawrence, where the vessel was sunk in collision and 1,200 perished, and there made the experiments on which his invention is based.

In a thick fog, when two vessels are approaching each other, it is often impossible for the captains to tell within 45 degrees the direction of the sounds from horns. In the St. Lawrence disaster the masters of both vessels should have stopped, in his opinion, in view of the uncertainty of determining the direction of signals in fog.

First Professor Webster showed a resonator or "phone" which took up the vibrations of a tuning fork and emitted a sound of standard pitch. This instrument took the place of a regular fog signal. The receiving instrument, or phonometer, looked like a small round box on a tripod, and from each end of the box projected a conical horn resembling a megaphone. The small ends of the horns were turned toward each other.

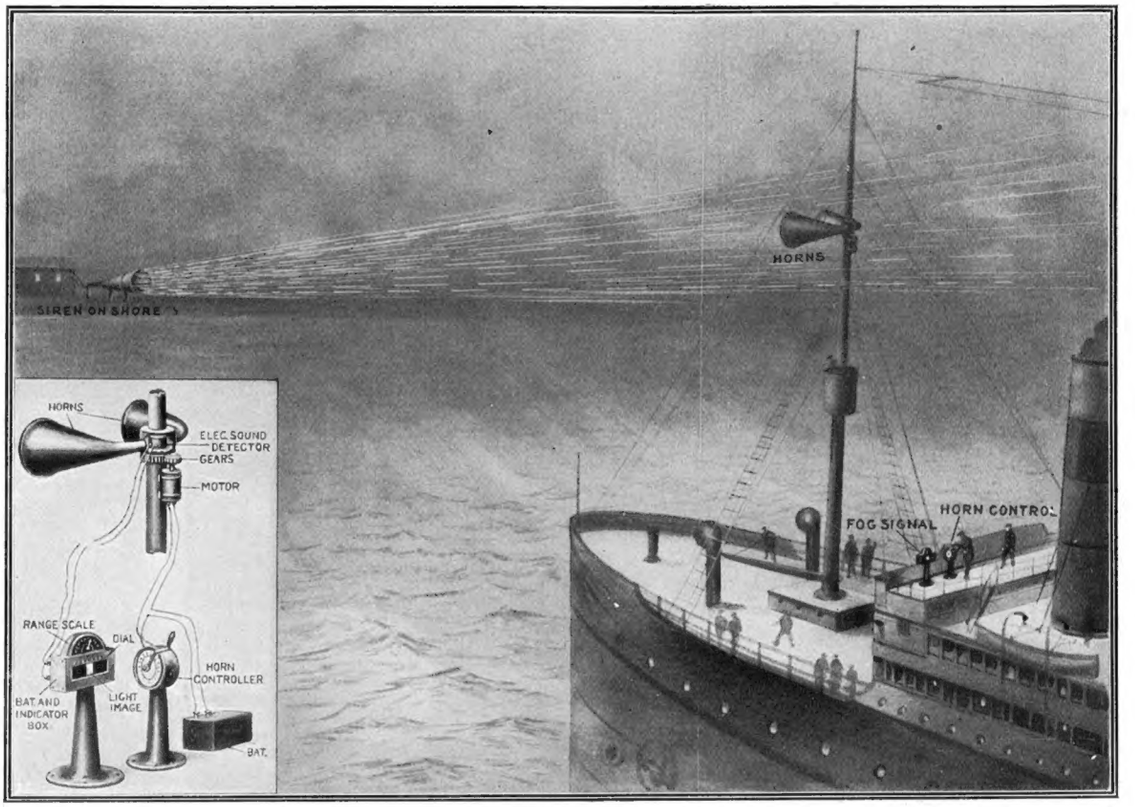
The device is placed so that the horns are at right angles with the course of the vessel on which it is installed, as seen in our illustration. The vibration caused by the signal is concentrated by the horns and communicated to a metal diaphragm, which is held in place by small steel wires. The pulsation goes to a tiny electric light, and the effect upon it is registered by the reflections of a mirror on a scale which can be read through a glass attached to the instrument (see detail insert cut). The scale shows the intensity of the sound as the image of the light widens or contracts. The horns swing easily upon a pivot (readily controlled from the ship's bridge by an electric controller as depicted, hooked up with a small electric motor geared to the rotatable horn chamber mounted on the mast). When they have been so adjusted by the operator that they show the greatest intensity, the tube of the instrument is pointing in the direction from which the signal is being sounded.

With the phonometer, although it is not absolutely accurate in its present stage, Dr. Webster declares that the direction can be determined within a very few degrees. Experts who witnessed the demonstration said that if the device could show within five to 10 degrees it would be of incalculable value.

The inventor himself saw a practical objection to the device in that to have it of universal use the navigation laws would have to be changed so as to prescribe that all fog horns and sirens be of the same pitch. As at present the actual variation of horns is within an octave or an octave and a half, he does not regard this objection as insuperable. He thinks that the Government of the United States would be well within its rights in standardizing fog horns. It would be too much to expect the masters of vessels to tune up their phonometers to correspond with the timbre of every new siren. In connection with wireless messages, it is believed that the phonometer would be of value, for ships approaching each other could communicate details about the fog horns employed as a further guide.

Dr. A. A. Michelson, of the University of Chicago, said: "I cannot withhold my admiration. This paper marks a most notable advance in the effort to solve a problem of the greatest interest. It seems to me that Dr. Webster has brought to a brilliantly successful conclusion this important research."

It seems that an important function of this phonometer would be in discovering and locating the whereabouts of icebergs. This could be accomplished by sending out a siren note so that it would be reflected, in the form of an echo, from the iceberg. By measuring the reflection angle at two different points, say at either end of the ship, it would be possible to quickly calculate the distance at which the iceberg was situated. This follows the same practise used in getting the range for big guns.



Remarkable Scientific Visual Fog Signal Receiver Devised by Dr. A. G. Webster, of Clark University. Insert Cut at Left Shows Details of Receiver Mechanism.

DRIVES AIRSHIP BY WIRELESS.

The invention of a German engineer, Herr Bohle, which he demonstrates nightly in a large vaudeville house of Berlin, is attracting considerable attention. The invention consists of an airship in miniature (about 3 meters long and 1½ meters in diameter), which the inventor drives by means of wireless electric currents from a battery stationed afar. No personnel is required to drive this airship, which executes every maneuver the inventor desires. Even explosives can be dropped from this airship on high at the will of its master at his station below, it is claimed.

Expert engineers declare that the great question is whether this airship can be constructed on a larger scale and managed from a greater distance. If so, another upheaval in military warfare may be expected.

ELECTRIC COMPASSES ON AMERICAN BATTLESHIPS.

Motor-driven gyroscopic compasses have now been installed on 20 United States battleships, one armored cruiser and 15 submaries. Master compasses in duplicate are soon to be placed on all battleships of the Delaware and later classes. The Bureau of Navigation maintains with the Atlantic fleet two chief gunners who have been specially trained as gyro-compass experts, and it is the duty of these men to inspect and adjust the compasses and to give instructions in their use. Special attention is also given to the instruction of officers and men in the care and use of the compasses, the ship's crews who have to do with these compasses being sent to the New York Navy Yard or the works of the manufacturer for 30 days' instruction.

High Voltage Switch Arcs That Resemble Lightning

THE spectacular set of photographs on the opposite page are not those of lightning discharges, although they very much resemble them indeed. They happen to be the arcs occasioned when opening high tension transmission lines with air-break switches.

These photographs were taken during night tests made on the efficiency of air-break switches for high tension transmission lines at the Virginian Power Co.'s generating plant at Gainesville, Ga. Oscillograph records were also made to show the fluctuation of the currents on the lines, due to the heavy arcs formed when these swtiches were suddenly opened. The tests covered the performance with lines carrying actual energy loads of considerable amperage and, also, with simply a charging current load, which latter reached a value of 22 amperes on the average, with a leading power factor.

Referring now to the illustrations here shown of the arcs created when opening some of these air-break switches, the upper left view shows the spectacular effect due to breaking a line of 50,000 volts potential and 18 amperes of current. Note the wavy formation of the flaming arc produced. It is certain death to be within sparking distance of such a discharge. It lasts usually only a fraction of a minute, or until it has opened the circuit.

The top central photo shows the appearance of the arc when the switch is opened on a 114,000 volt, 27.5 ampere line. Particular attention is called to this excellent picture with respect to the ladder seen in same, and some idea as to the size of the discharge or flame may be thus obtained. This particular flame discharge was over 20 feet high! The ladder is a regular standard size one. The arcs blew downward, then between the phases, with loud reports and also overlapped the overhanging leads. Considerable heat usually accompanies these arcs in air.

The illustration in the upper right corner portrays the arc effect taking place when a 64,000-volt line, carrying 18 amperes, is suddenly disrupted with an air-break switch. Here the arcs were almost perfectly straight between the switch blade and horn, and measured about six feet long. Note the beautiful curved shape of the arcs. The horn wires of the air-break switches are clearly observed.

The lower left view is that of the arc occurring when opening a 111,000-volt line carrying 26.8 amperes. Here the arcs measured about 12 feet long and they tended to hold to the lower part of the blade, breaking before rising along the horns. A particularly fierce and hot arc formed here, and attention is called to the wavy ribbon-like effect developed at the upper end of the flames.

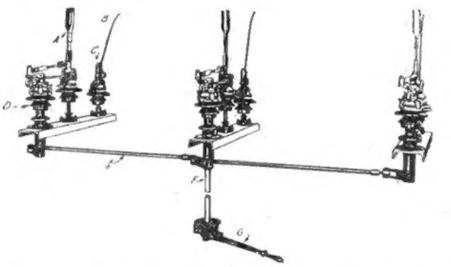
The lower central illustration is that of the air-break switch arc on a 76,000-volt, 21-ampere transmission line. A slight wind was blowing at the time this switch was opened and tended to blow the arcs sidewise. The arcs proper measured about eight feet long, but finally broke all right in a short time. The discharges are more concentrated, apparently, but evinced the same persistency in hanging on as those previously cited.

The final photo, shown in the lower right corner of the group, depicts the performance of one of these switches on a 118,000-volt line with a 21-ampere load. The arcs in this case were very long, but rapidly rose up the diverging horns, and thus got out of the way of the framework and finally broke all right. Note the great spread of the arc flame at the extreme right of this view. The diverging horns of these air-break switches are supposed to cause the arcs to rise quickly and thus lengthen out and become broken finally, but in some instances this action does not take place as per schedule, giving rise to some of the spectacular arcs here portrayed.

These tests were conducted for the purpose of determining the effect on the transmission lines of breaking the circuit with air-break switches, as compared with oil switches, and for the purpose of determining the arcing characteristics of the three different type switches tested.

None of the switches were sufficiently spaced, and the tests proved the minimum distance between phases recommended for 44,000 volts should be at least seven feet. As constructed for these tests one switch was spaced six feet between phases and the others only four feet.

It was found that extremely high winds of about 50 miles per hour velocity greatly aided in breaking the arcs formed by light loads, as the arcs were blown from the diverging horns before the switches were even wide open; but under heavier loads, with the spacing of phases used in these tests, the high winds would blow the arcs across the phases and trip the circuit breakers at the power house before the arcs



Type of Three-Phase Air-Break Switch Employed in Opening High Tension Power Lines. The Insulated Handle G and Shaft F, Swing the Crossbar E. This Turns the Insulated Spindles D, Linked Up to the Switch Blade A. The Jaw of the Switch Appears at C; While B Is the Horn Arc Arrester. Three Switches Are Thus Controlled by the Handle G.

would let loose from the horns or blades. The conclusion was also reached that it was much more difficult to break simply a charging current load than a true energy load of the same K.V.A. value. (One K.V.A. equals 1,000 watts at 100 per cent. power factor.)

The testing engineers stated as their opinion that the proper design of an air-break switch involved a mechanical movement in opening the switch that would aid the arcs in rising up the horns. The theory that the heat of the arc alone will carry it up the horns is doubtless well founded, but this force is only great enough to accomplish this result in a perfectly still atmosphere. With the slightest wind blowing, the arcs are blown sidewise and the tendency of the arc to rise more or less counteracted by this horizontal wind pressure. If, however, the mechanical movement is such as to draw the arcs up the horns, the tendency to rise is increased, and it is much easier then to break the arc. The arc appears to be a sort of uncontrollable featherlike medium, and but a slight wind will blow it eight or ten feet horizontally.

These tests were made in all kinds of weather, such as snow, rain and clear weather.

The chief difficulty experienced in the use of air-break switches is the large amount of space necessary for their construction, and it is plainly apparent that the spacing used by manufacturers of to-day is not sufficient, it seems. In some cases the arcs are blown downward, and this means that the switches must be well insulated from the steelwork supporting them for a distance sufficient to keep the arcs from thus grounding the lines.

These wonderful photographs were obtained through the courtesy of Charles O. Lenz, chief engineer for the Virginian Power Co. and the Georgia Railway & Power Co.

"EDISON DAY" AT 'FRISCO EXPOSITION.

On October 21 the whole country celebrated "Edison Day," commemorating that eventful day just 36 years ago when the first Edison electric incandescent lamp was perfected.

At the Panama-Pacific Exposition in San Francisco, where Mr. and Mrs. Edison were guests, a telephone connection was made between Mr. Edison's home, at West Orange, N. J., and the fair grounds. While the inventor, aided by a special sound amplifier, listened in San Francisco, a long message from Miller Reese Hutchinson, superintendent of the Edison Works, was transmitted by Mr. Edison's own phonograph.

The message congratulated Mr. Edison on the 36th anniversary of his invention of the incandescent light, and told him that several hundred of his friends had gathered in his home to do him honor.

Mr. Edison's reply was received by his latest invention, the "telescribe," and later every one in the room received a cylinder on which the words of the inventor had been transcribed automatically.

Many people of prominence journeyed to Edison's home and found the streets about it lighted by 5,000 candle-power lights, while immense searchlights played on it from the roof of the laboratory.

The trans-continental wire worked perfectly, and the voices of all those who spoke were heard distinctly. Mr. Edison's voice preserved all its characteristics in the transmission over 3,400 miles, and those who knew him instantly recognized the speaker. Mr. Edison, in turn, assured those in his laboratory that he heard perfectly. He then said:

"It may seem strange to those who know of my work on the telephone carbon transmitter that this is the first time I have ever carried on a conversation over the telephone. Trying to talk 3,400 miles on my first attempt at a telephone conversation seems to be a pretty big undertaking, but the engineers of the Bell System have made it easier to talk 3,400 miles than it used to be to talk 34 miles. In my research work I have spent a great many years listening to the phonograph, but it gives me a singular sensation to sit here in California and hear the new diamond disc phonograph over the telephone all the way from Orange, N. J. I heard the record of Hutch's talk very plainly. I should now like to hear a musical record.

"That's fine," he said, after a record had been played. He was asked to play the record back from San Francisco and a machine at that end was started and the West Orange audience heard the music.

John J. Carty, chief engineer of the American Telephone and Telegraph Co., who was "listening in" at Chicago, said:

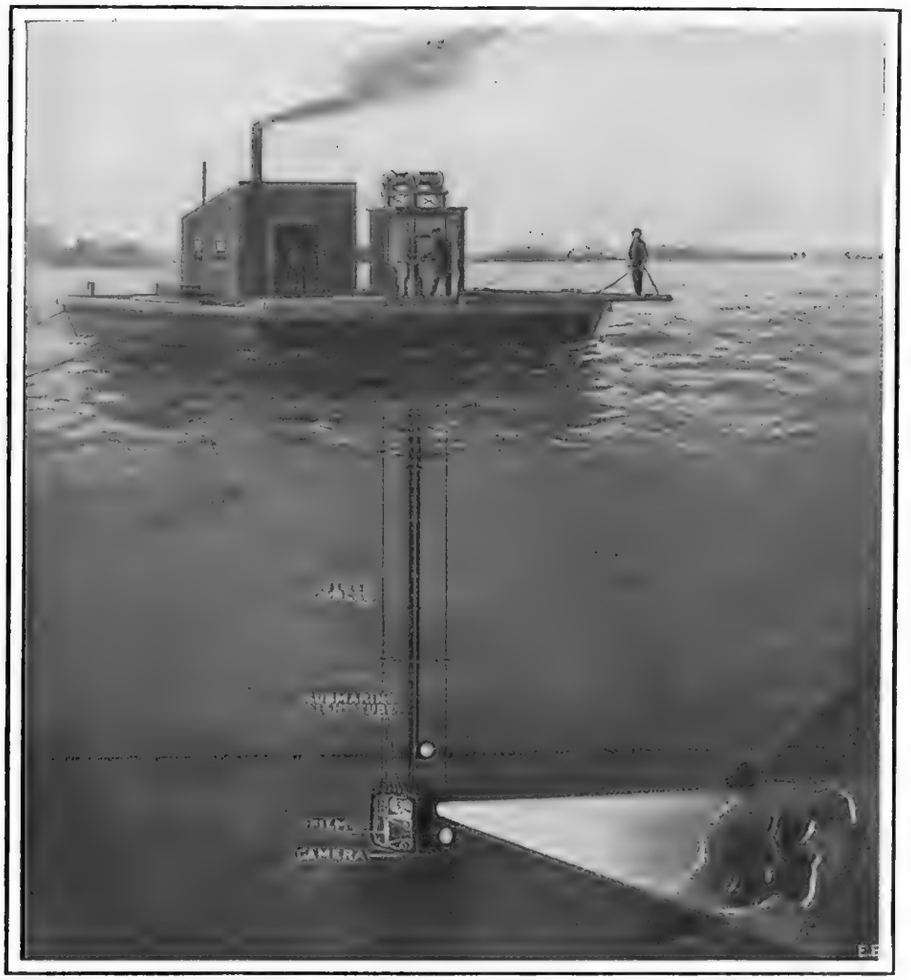
"This wonderful transmission of sound will become historic because of the conveyance of a perfect recreation of music and voice to the ear of the world's most illustrious inventor by his own invention."

50,000 Volts and 18 Amperes Broken by Air-Break Switch on a High Tension Transmission Line.
Breaking Three Phases of Transmission Line at 114,000 Volts and 27.5 Amperes. Flames Measure Over 20 Feet in Height.
Peculiar Arc Effect When Opening Air-Break Switches With 64,000 Volts and 18 Amperes in Line. Arcs Measured About 6 Feet Long.
Fierce Flame Effect Developed Upon Opening These Switches Carrying 111,000 Volts and 26.8 Amperes. Note Wavy, Ribbon-like effect at end of Arcs.
When a 76,000 Volt, 21 Ampere Transmission Line Was Opened. A Slight Wind Was Blowing at the Time, Tending to Blow the Arcs Sidewise. Arcs Measured About 8 Feet Long.
How the Electrical Discharge Appeared When the Three Phases of a 118,000 Volt, 21 Ampere Circuit, Were Interrupted.

SPECTACULAR ELECTRICAL DISPLAYS OCCURRING WHEN HIGH TENSION AIR-BREAK SWITCHES ON TRANSMISSION LINES ARE OPENED

Taking Moving Pictures with Under-Sea Searchlight

Some time ago there was developed a special submerging bell made of heavy steel and of sufficient size to accommodate a powerful searchlight, together with a motion picture camera and also the operator for same, so that moving pictures of the beds of rivers, coral formations, wrecks, etc., might be taken. Instead of going to such expense and trouble, there is suggested and illustrated herewith a much simpler method which would seem just as effective.



Proposed Scheme for Taking Submarine Motion Pictures by Means of Powerful Electric Searchlight Worked in Conjunction with the Camera From Above the Water's Surface.

In this arrangement there is provided a set of four steel cables properly rigged up with winding drums, etc., on a float or raft, as perceived, and at the end of these cables is secured a motion picture camera, electrically controlled by means of insulated wires leading down one of the cables and secured thereto. In the top of the camera is mounted a powerful electric lamp with lens, etc. The operator on the surface is enabled to view the wreck or other submarine scene through a periscopic tube, more properly known as a "mariscope." The sighting tube may be turned in any direction and, of course, the camera may be raised and lowered to any depth or height in the water desired.

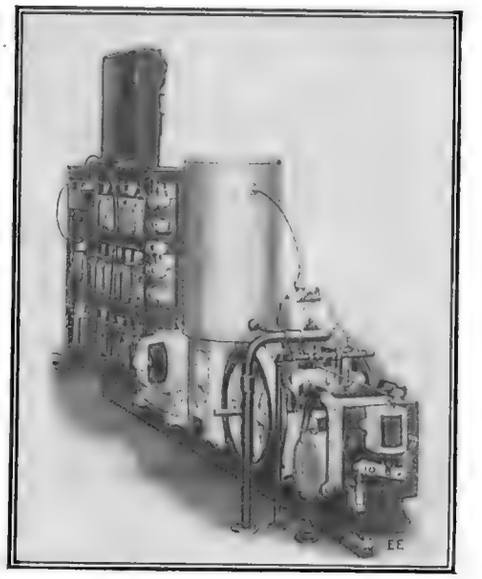
The cables, as will be evident, are wound up over the drums on the float or raft, and to enable this function to be performed properly the mariscope or sighting tube is made in the same fashion as a telescope, i. e., of gradually decreasing sizes of tubes sliding one within the other. A substantial watertight camera and high candlepower lamp are necessary for this purpose; the machine could be constructed of steel and provided with a properly fitted door for permitting a new film to be readily inserted and the old film removed when the device is above water. A storage battery or dynamo on the float will supply current for the lamp, and camera, and pictures can be taken in this way either in the daytime or at night. Undoubtedly many wonderful and valuable pictures could be taken in this way which would not only be instructive for use in theaters, schools, etc., but also vitally important to lecturers on certain subjects and for the benefit of salvage and wrecking companies which have to deal with submerged boat wrecks and the like.

AN AUTOMATIC ELECTRIC LIGHTING PLANT.

The problem of electric lighting as regards ease and convenience has been satisfactorily solved in cases where central station service is available, as all that is required is the turning on of a switch. In country houses and private installations of a similar description, however, unexpected difficulties have been encountered, such as the requirement of frequent attention and the employment of some technical man in order to look after the apparatus.

It is, therefore, interesting to note the arrangement of a recently devised automatic lighting generator set which works at all times whenever its services are required. This plant is shown in the accompanying illustration and is the product of an enterprising electrical concern of New York. No attendant is required to start and stop the plant, but it is sometimes necessary to fill the tank with water and to clean and oil the engine, which does not require much technical knowledge. To start the plant it is only necessary to switch on three or four storage batteries, which supply the power; these are shown on the extreme left. As soon as an additional lamp is turned on more current is consumed and a relay is actuated which connects the dynamo to the batteries, which then acts as a motor. This in turn drives the engine until the proper normal speed of same is attained, and at the same time electrically firing a gasoline charge in the engine, which causes it to run and thereby drives the dynamo. As soon as the dynamo begins to generate, a relay is thrown automatically, connecting the lights to the dynamo mains; also, the storage batteries are then being charged. The most interesting point about the engine is that it will run faster when additional lights are put in circuit. This is accomplished by means of an automatic control operating the gas valve, and which is actuated by the current that is supplied to the line.

This is another advance in the realm of the isolated electric plant, and one which undoubtedly will be advantageous to those who lack central station electric service, as in the Middle West and suburban sections all over the country.



Remarkable Electric Lighting Plant That is Entirely Automatic in its Action. Turning on a Single Lamp Starts the Engine and Dynamo, Charging the Storage Battery, etc. It Stops Itself as Soon as All the Lamps Are Extinguished.

TRAFFIC COP AN ELECTRIC SIGNALMAN.

The traffic policeman in Cleveland has been turned into a "signal officer." The green and red lights adopted on railroads have been installed on all Cleveland's main street corners. Electric lights facing oncoming vehicles and hid from view in the opposite direction are located on the right hand side of each street. The red light denotes "Stop," the green light "Proceed." To clear the crossing in case of fire the officer simply throws on an emergency switch, which sounds an alarm bell and turns on red lights.

NOVEL ELECTRIC CLOCK INDICATES TIME DIRECTLY.

By Felix J. Koch.

"I set my clocks by Edward's watch," the young housewife remarks proudly, as you marvel that every clock in Newly-Wed's home strikes the hour in unison with all others; and this with the time absolutely correct.

"Edward, you know, sets his watch each evening by the big clock at Fifth and Vine streets," and as does "Edward," so does everyone else in Cincinnati; for, in addition to achieving renown for being the most complicated and largest electric clock in the American mid-west, this clock is known to be absolutely correct.

In fact, already, this clock, mounted on the corner of a leading department store in the Queen City, has become a feature of the place.

In addition to being operated by electricity, the correct time comes to the clock from the Western Union people every second. Some notion of the complexity of the arrangement for keeping it exact is to be gained by the statement that in putting it up the services of five men were required for some ten days, and that not less than five miles of wire is used between clock and store. Innumerable lamps are required to give the proper arrangement for displaying the changing time by night, when the clock is, of course, at its best; and with these the connections must be exactly right. To that end, again, the electricians state, there are 800 connections in all. If one of these goes wrong, they are all wrong.

While in course of construction the big clock was tested every two hours, now it is looked over four times a day. In fact, five men were put in charge to test and connect.

And yet, wonderful as it may appear, these experts are on hand, as precaution alone, since *de facto* the great clock now runs itself and does not need this checking up.

Day and Night Views of Unique Electric Clock That Indicates Time Directly in Hours and Minutes, as Observed.

What is more, a clock of this sort will last well-nigh forever. With a dial of 12 inches diameter, the clock itself measures 18 by 36. With sign and other ornaments besides, then, it measures 12 by 15 feet.

Naturally, to the expert, the big clock presents the solution of many problems indeed; but the public finds greatest interest here in watching the momentary changing of the sign when it states:

"The Correct Time Is,"

and then gives this, in hours and minutes, as the illustration shows.

Some Modern Applications of the X-Ray

In order that this country may preserve its strict neutrality, and fearing that the Germans or their sympathizers may place bombs or infernal machines, or copper (which is contraband), in bales of cotton, such bales are daily inspected, the operator's body is exposed to the rays, and to protect him from their injurious effects a lead screen is placed in front of the examiner, as our photograph illustrates.

Photo Copyright by Underwood & Underwood.

Powerful X-Ray Machine Used by United States Government to Detect Bombs, etc., Hidden in Cotton Bales Before Shipment.

our Government has taken advantage of the X-rays.

The photograph herewith shown depicts a bale of cotton being examined by a powerful X-ray tube for any concealed contraband. The high-voltage direct-current machine is seen at the left: this is one similar to that described in the April, 1915, issue of this journal. The current is transmitted to the tube on the right by two flexible copper conductors. The tube is supported by means of an adjustable stand, as perceived. Due to the continuous use of the machine, as thousands of Note the operator viewing the bale through a phosphorescent or platinum-barium-cyanide screen.

Another application of the X-ray is in detecting marked impurities in coal. This was suggested by S. Cohen, who explained that as carbon is very transparent to the Roentgen rays, while silica is opaque to them, the silicate which is the most common impurity in coal and which forms a slag when coal is burned, can be seen like a skeleton when the shadow of the coal is projected upon an X-ray fluorescent screen.

Another possible use of the X-ray is in testing precious stones such as diamonds. A real diamond is practically transparent to the ray, giving almost no shadow on the screen, while imitation diamonds are opaque to them.

AMATEUR GETS SPECIAL RADIO LICENSE.

The wireless station of John J. Grossman, 181 Hudson street, Tiffin, O. (formerly 8TI), has been recently converted into a special station by Radio Inspector J. F. Dillon (new call 8ZT). This station will be engaged in flood service and newspaper work. He will be glad to hear from anyone wishing assistance in relay work. Working hours, 7 p. m. to 10.30 p. m. Address all communications to above.

THE WASTE IN WOMAN POWER.

No one cares to think of the work that women do in terms of horsepower, least of all the women themselves, but a moment's study of these figures is startling in its revelation.

There are now 15,000 six-pound electric laundry irons in use in a large Eastern city. Few women and no men realize what this means in actual labor saving. Where one electric flatiron is now used the housewife formerly required at least three six-pound "sad" irons, and while one was in use two had to stand on the stove to heat. Fifteen thousand electric irons have therefore replaced 45,000 "sad" irons. At six pounds apiece, this means 270,000 pounds, or 135 tons.

Now, the constant use of this enormous amount of old irons meant a tremendous outlay of energy or exertion of strength that was required every ironing day, equivilent to 2,400 horsepower, and this was simply termed "woman's work!" It should be termed the waste of woman power!

Ball Lightning

BALL lightning, the subject here under discussion, is one of the three principal and distinguishing forms of this marvelous electrical disturbance taking place in nature, and which in its commoner forms all of us have undoubtedly witnessed at some time or other. These three principal forms of lightning, as this electrical phenomenon is called, comprise ball lightning, as just mentioned; streak or chain lightning, as manifested by powerful discharges taking place near-by, and the third form covers what is commonly termed sheet lightning. This latter is sometimes of an indistinct character, and may not be very noticeable, and this is often caused by lightning actually taking place at a considerable distance from the observer, which reflects from the clouds or firmament. This also includes the form of branched or forked lightning bordering on the kind just mentioned, or combined with it.

Ball Lightning or "Fire-Ball" as it Appeared in France Some Years Ago. It is Supposed to Be a Gaseous Sphere Carrying an Electric Charge, and Is Liable to Explode if Impeded in Its Travels.

Most of us know how to protect ourselves from this pyrotechnical display occurring in nature, and one of the best ways is to recline in a hammock suspended in the center of a room with respect to the four walls, floor and ceiling, the hammock being hung preferably on silk ropes. It should not be placed under a chandelier. Care should be exercised in keeping away from open windows, doors, chimneys, fireplaces and stoves, or, in fact, any metallic or conductive body which might tend to gather a charge or act as a highly conductive path for a lightning discharge which might strike the building. It is a pretty thoroughly accepted axiom to-day that if a building is properly protected with well-grounded lightning rods that they will cause any lightning discharges to proceed harmlessly to earth without any spectacular effect, such as noise or auroral display. It is best during such electric storms to keep the doors and windows closed, as a draft of air often causes a lightning discharge to enter through such openings. Soot-covered chimney flues are another attraction for lightning discharges.

Ball lightning is one of those freakish things which one seldom sees, yet one that does really take place, as many witnesses of such displays are willing to swear to, including a number of irreproachable scientific writers, such as Camille Flammarion. In case ball lightning enters a room it is best to get on a chair or some other article, so that the fire ball may not roll along the floor and burn the person. If the door is left open, the fire ball will most likely proceed on its way. Should one be standing on the floor near the door, it is possible that the ball might explode between the legs and cause fatal injury, as has occurred in a number of cases. Hence the precaution of standing on a chair.

Ball lightning, or the thunderbolt, as it was called by the Greeks, is a gaseous sphere without an envelope. It contains energy which is afterward released with explosive violence.

(1) It is a luminous ball which often occurs after an intense flash of lightning.

(2) As it falls it moves slowly and horizontally some feet above the earth.

(3) At sea it is most frequent.

(4) The mass of a thunderbolt is denser than air. In an air current of ether, or in the neighborhood of electricity, it explodes, and the explosive wave travels outward, followed by a strong smell of ozone. Then the ball is nothing but atmospheric gases, because:

Ozone is denser than air, and is produced under electric stress.

Ball lightning travels horizontally to the negatively charged earth. That it is repelled proves that ozone also is negatively charged. The energy liberated causes a transition of ozone to oxygen, and thus explains the explosion, as it is well known that oxygen supports combustion.

The illustration herewith presented shows a ball of lightning entering a stall in France. It rolled for a few seconds and finally moved toward the chimney, where it exploded with great violence.

Not long ago Count G. Hamilton made a record of a similar freak of electricity. He was sitting at dinner in a house on Lake Wener in Sweden when, just after a vivid flash of lightning, a brilliant white ball appeared, and, after hanging poised over the table for a few seconds, exploded with a loud crash. Fortunately it did no harm to anyone, although it was quite close to several people.

The most amazing effect of lightning was witnessed several years ago in a French field. During a thunderstorm several peasants took shelter near a tree, and a few minutes later a globe of lightning drifted toward them, like a soap bubble of blue fire. It surrounded them, injuring them to the extent of burning their hair and clothes, after which it exploded.

We hardly dare to experiment with lightning in any form as found in Nature. Several investigators have been killed outright by ball or other lightning discharges. Notable in this direction is the case of Dr. Richmann, who lost his life through such research work indiscreetly conducted. He had arranged an insulated iron rod from the roof of his house to his laboratory. This served to conduct the atmospheric electricity to him, and he made a practise of carefully measuring its intensity every day. However, on the day of August 6, 1753, in the middle of a terrific electric storm and while he kept at a safe distance from the metallic rod, awaiting time to measure the spark length, his assistant suddenly entered the laboratory, causing Dr. Richmann to momentarily approach the rod. A brilliant globe of blue fire leaped from the rod and struck him on the head, stretching him out on the floor, stone dead. Our front cover illustrates this sad occurrence vividly. This, to be sure, was hardly an encouraging start to the study of physics and science.

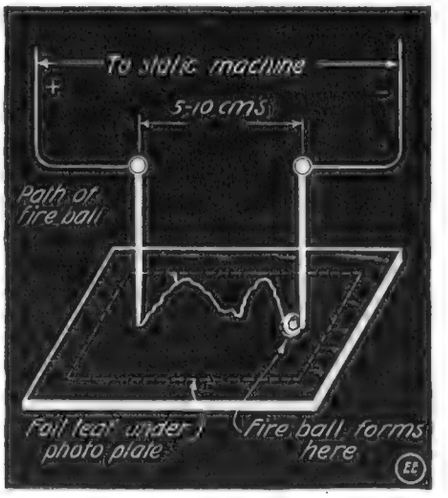
Camille Flammarion, the famous French scientist, cites several very interesting cases of "ball lightning" discharges. One of these occurred on August 24, 1895. During a violent wind and rainstorm several people saw descending to the ground a whitish-colored globe of about 1½ inches diameter. Upon touching the ground it split into two smaller globules which rose at once to the height of the chimneys on the houses close by and disappeared.

One leaped down a chimney, crossed a room in which were a man and a child without harming them. It then proceeded through the floor, perforating a brick with a clean round hole about an inch in diameter. Under this room was a sheepfold. The shepherd's son, seated at the doorway, suddenly perceived a brilliant light shining over the flock of sheep, while the lambs were jumping about in fright. When he approached them he was startled to find that five sheep had been killed. They bore no trace of burning, or of any wound whatever, but about their lips appeared a sort of slightly pinkish foam.

In the adjoining house the second fireball had also gone down a chimney and had exploded in the kitchen, causing great damage.

A peculiar freakish effect often noticed and recorded in numerous instances is where ball lightning has appeared suddenly, passed through and around a number of people in a crowd, etc., and then as suddenly disappeared without doing any harm whatsoever.

In July, 1744, a German peasant woman was busily occupied in the kitchen superintending the family meal, so history relates. Instantly, after a terrible clap of thunder, she saw a fireball about three inches in diameter come down the chimney, pass between her feet without harming her and continue on its course nonchalantly without burning or even upsetting the spinning-wheel and other objects on the floor.



Scheme for Producing Ball Lightning in the Laboratory with Static Machine, Photograph Plate and Two Needles.

Terribly frightened, the woman tried to escape—she threw herself toward the door and opened it, when the fireball proceeded to follow her, playing about her feet, and passing into the next room, which opened out of doors, crossed it, and went on out

AN ILLUMINATED CLOCK FACE.

A certain kind of sign recently placed on the market consists of a heavy sheet of plate glass in which the design is deeply sand-blasted. The source of illumination is entirely hidden, and the light is reflected up

Electrically Illuminated Clock Dial in Which the Light Is Reflected Edgewise Through the Glass.

or down, edgeways, through the glass, thus giving a very pleasing and mysterious effect. The same plan has been followed in the design of the clock face shown in the accompanying illustration. The clock can be made to conform to any architectural design and may be provided with or without background. The frame for the clock may be either square, hexagonal or octagonal, employing four lamps, six lamps and eight tubular "linolite" lamps, respectively. The figures seem to stand out in space, giving an extremely novel and pleasing effect.

COLLEGE MEN TALK TO 'FRISCO.

A telephonic conversation between members of the faculty, alumni and student body of Stevens Institute of Technology, Hoboken, and President Alexander Humphreys and members of the alumni was held recently over the new line between New York and San Francisco. Dr. Humphreys was attending the organization meeting of the Stevens Club in San Francisco.

Twenty alumni of the institute formed the club, among them Dr. John C. Carty, chief engineer of the American Telephone & Telegraph Co., an honorary alumnus.

The exchange of greetings between the 'Frisco and New York parties began at 9 p. m. and lasted an hour. The telephone connection for the 3,000-mile talk was made in two minutes. At the conclusion of the conversation those in San Francisco held a banquet.

Those in the New York party included Prof. Albert F. Ganz, Prof. Adam Riesenberger, Prof. Charles F. Kroeh, all members of Stevens faculty; Newcomb Carlton, president of the Western Union Telegraph Co.; John Lieb, vice-president of the New York Edison Co.; Dr. David Jacobus, President Warner, of the Stevens Class, and Secretary Dunn, of the Students' Council. They gathered in the directors' room of the American Telephone & Telegraph Co., at 15 Dey street, New York.

FLASHLIGHT THAT LOOKS LIKE A WATCH.

The latest thing in electrical flashlights of the pocket type is that shown in the illustration and which corresponds exactly in size and appearance with an ordinary watch. The lamp is lighted by pressing on the stem and the specially designed battery is easily replaced by opening one side of the watchcase. This flashlight gives a strong beam of light and is probably one of the neatest designs of its kind brought out in a long time. It will appeal particularly to those wearing a double or breast

Flashlight That Looks Like a Watch, the Latest.

watch chain. This particular flashlight is known as the "Watchlite"; it is fitted with a tungsten lamp of the proper candlepower to be used in conjunction with the battery supplied with the device.

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into the yard. The fireball darted about the yard, entered a barn by an open door, climbed the wall opposite and, reaching the edge of the roof, it burst with such a terrific noise that the peasant woman fainted. The barn at once took fire and burned to the ground.

Another peculiar instance took place in 1903, while M. Lawrence Rotch (director of the observatory at Blue Hill, U. S. A.) was sojourning in Paris, France. It had for its locale the famous Eiffel Tower, rising majestically 1,000 feet above the earth in graceful outlines. Looking in the direction of this lofty steel structure during a heavy electric storm he saw the summit struck by white lightning coming from the zenith. Simultaneously he saw a fireball, less dazzling than the lightning, slowly descend from the summit to the second platform. It appeared to be about one yard in diameter and consumed less than two seconds to cover a distance of about 100 yards. Then it suddenly disappeared in a mysterious manner. The next day Mr. Rotch ascertained, on visiting the tower, that it had actually been struck by lightning *twice* on the previous day. It is to be noted that the ball did not follow the conductor; but, after all, the whole metallic tower structure certainly is in itself the most powerful lightning conductor imaginable. The enormous mass of steel rising skyward would undoubtedly neutralize in such a case the attraction of the thin metallic lightning rods, effectual for the protection of ordinary buildings, but apparently incapable of competing under such conditions with the attractive force of this gigantic metallic mass.

A thunderstorm burst over Mortrée (Orme), in France, on April 24, 1887, where the lightning played havoc in general. It literally chopped up the telegraph wire on the route to Argentan for a distance of 150 yards. The sections of the wire were so blackened that they could well have come from a forge; some of the longer ones were bent and their sections welded together. The lightning in one case entered a stable door in the form of an iridescent fireball. It approached a person who was preparing to milk a cow, and shortly afterward passed between the legs of the animal and disappeared without causing the least damage at all. The terrified cow raised itself on its hind legs, bellowing frantically, and its master, nearly frightened out of his life, ran away to a more secure place of refuge.

However, the apparently inexplicable phenomenon accompanying this unwelcome pyrotechnical display of Dame Nature was that occurring at the critical moment when the lightning crossed the stable, at which instant a considerable quantity of incandescent stones fell before a neighboring house. Some of them were the size of walnuts; they were, furthermore, not of a very thick material, had a grayish-white color, and could be easily broken by the fingers, when they gave forth the characteristic odor of sulphur. The smaller spheres exactly resembled coke. These facts just mentioned were set down at the time by the Minister of Post and Telegraphs.

It is possible to produce artificial fireballs or ball lightning, as it is more generally called, in the experimental laboratory. A suggestion to this end is given herewith, this idea being due to M. Stéphane Leduc, the noted French scientist. His experiment makes possible the production of a slowly moving globular spark not easily obtainable in any other way, in so far as we know.

To produce this imitation ball lightning it is necessary to employ two very fine highly polished metallic points, each of which is in connection with the positive and negative poles, respectively, of a static machine of small or medium size. These two metallic points must rest perpendicularly, as our illustration indicates, on the sensitive face of a gelatine bromide of silver photographic plate, which is placed on a metallic leaf, such as tinfoil. The two metal points are spaced about five to ten centimeters apart. When the static machine is operated an effluvium is produced around the positive point, while at the negative point there is formed a luminous fireball or globule.

Now, when this globule has reached a sufficient size, it will be seen to detach itself from the metallic point, which then ceases to be luminous, and the globule will begin to move forward slowly over the surface of the plate, taking various curved paths and eventually it will set off in a direction toward the positive metal point. When it reaches this electrode the effluvium is extinguished and all luminous phenomena ceases. Further, the static machine acts as if its two poles were short-circuited, or, in other words, united by a conductor.

The velocity acquired by the luminous globule as it travels is quite slight, it taking from one to four minutes for it to traverse a path of six centimeters in some cases, and before reaching the positive electrode the globe bursts into two or more luminous balls which individually continue their journey to the positive electrode. On developing the photographic plate (which, of course, should be placed under a ruby light while the foregoing experiment is conducted) there will be found a trace on it of the exact route followed by the spark globule—the point of explosion, the routes resulting from the division, and the effluvium around the positive electrode point. Also, if one should stop the experiment before the globule's arrival at the positive electrode, the photograph will only give the route to that point. The fireball takes for its course the conductor, which apparently short-circuits the static machine. If sulphur or some other powder is thrown on the photographic plate while the experiment is being conducted, and also while the ball is moving, its path will be marked by a line of aigrettes, looking very much like a luminous rosary.

[*The Editors shall be glad to hear from any of our readers who have made experiments in this direction. Photographs are particularly welcome.*—ED.]

A submarine without electricity is as helpless as a baby. The electric current makes it easy of control by one man. It cooks, heats, ventilates, besides propelling this marvel of boats, when submerged.

Measuring the Heat of Distant Stars

TO most people it will probably seem a waste of time and a useless expense to undertake scientifically the measurement of the heat from distant stars. Undoubtedly the popular question in such a direction would be—of what earthly use such a scientific test could be? But we should at least listen to the logic and scientific deductions of Dr. W. W. Coblentz, of the United States Bureau of Standards, who says that the measurement of the total radiation from stars may possibly be of use to us in answering the question as to whether or not light is absorbed in traversing interstellar space. Many other highly interesting scientific aspects of this problem are involved, and we give herewith a brief discourse on the electrical apparatus used in this most remarkable test. It is extremely interesting to note the fact that the heat measurement of the radiations from "Polaris" (the Pole Star), made in August, 1914, are ether vibrations *which were sent out by that interstellar body 47 years ago.* More remarkable still is the fact that similar radiations from the "Orion" group of stars started upon their long journey through space 160 *years ago!* When one considers these facts, the distances involved are so inconceivable that one naturally wonders how it can be possible that there is not sufficient "cosmic dust" in interstellar space to scatter, and thus diminish, the visible radiations to a greater extent than the invisible adiations; and yet the spectrographic evidence seems to be against this sought-for absorption of light in space. Another question awaiting solution is whether there is a "dispersion" of light in space, i. e., whether there is a retardation of, say, the violet rays as compared with the infra-red rays, so that the infra-red rays get here quicker than do the violet rays. This scientific problem may be determined or solved by measuring the radiation from an eclipsing variable star. If there is retardation of some of the rays, then the maximum and minimum of light emission should be different for different parts of the spectrum.

This and many other vitally interesting scientific conundrums await further investigation and solution.

The measurement of star heat had been attempted a number of years previous to the research work conducted by Dr. Coblentz at the famous Lick Observatory on Mount Hamilton, Cal., in the summer of 1914. In 1895 and 1896 Minchin conducted such tests, using a 2-foot reflector. He utilized the well-known selenium cell, which changes its electrical resistance in accordance with the amount of light thrown on same. It was found, however, that this method was not satisfactory to any extent, owing to the peculiar properties of selenium, which is highly selective, for one thing, in response to the different wave lengths; thus it is impossible for comparison with the present data obtained of the radiations from the different stars. This cell, however, is of practical value in measuring the maximum and minimum light emission from a variable star which does not change in color. It was used for this purpose by Stebbins in 1910 in conjunction with a 12-inch reflector.

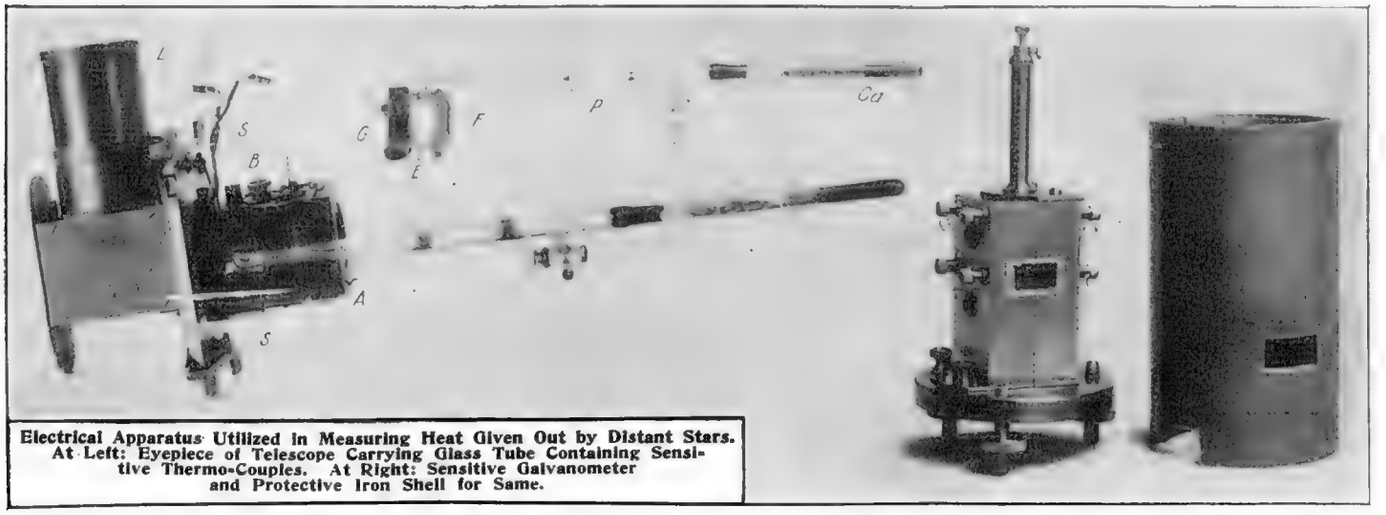
Taking up the work of Dr. Coblentz, the photograph herewith shows the apparatus he used and which was placed on the powerful telescope at the Lick Observatory. Extremely sensitive and specially made thermocouples were used in this test, and the heat (light beams) of the distant star was projected through the telescope onto the thermocouple junctions; this created an electrical current which was registered on a sensitive reflecting galvanometer. The galvanometer was shielded by a heavy iron shell, which is also seen in the illustration, so as to be free from any external electric or electro-magnetic influences caused by the various moving parts on the telescope as it followed the star across the zenith.

Referring to the thermocouples, these were composed of platinum and silver or bismuth and silver, in different cases, and encased in a glass chamber E; the projecting glass tube P was fitted with two electrical terminals employed for testing the evacuation value from time to time. In the front of the glass chamber E was placed a fluorite window F, through which the stellar rays were admitted, and which in turn fell upon the thermocouple, in this way producing a minute current, previously referred to. The star image and the receivers of the thermocouple were viewed from the side of the large telescope by means of a right-angle prism and lens which were mounted close to the glass window. The attachment L, containing the reflecting prism and the lens, is shown in the illustration herewith. The glass vessel containing the thermocouples is placed in a metal chamber B, attachable to the permanent equipment L by means of two thumb screws S S. In this way the radiometric attachment could be quickly detached and the regular photographic plate holder substituted, etc. The box B could also be rotated about the optic axis of the telescope. An absorption cell of water 1 cm. in thickness was placed in a hinged metal box observed at A. The resistance of the thin platinum wire used in making the thermocouple was very high, or about 2 to 3 ohms per millimeter. Only about 1.5 mm. of platinum wire was required. This wire was attached to a piece of silver wire 0.0165 mm. in diameter, which in turn was attached to the heavy lead wires. A globule of tin was attached to the platinum and pressed flat to form the receiver.

With this outfit as used by Dr. Coblentz it is possible to measure the heat radiations from stars down to the 6.7 magnitude. With this highly sensitive instrument stars were measured which were only 1/400 to 1/500 as brilliant as those formerly measured, or, in other words, the sensitivity was 400 to 500 times as great as previously attained. A very remarkable test of the sensitivity of the thermocouple radiometric outfit was made in connection with a sperm candle. It is asserted that the outfit was sufficiently sensitive to register the heat given out by a sperm candle when placed at a distance of 53 *miles from the thermocouple,* using a 3-foot reflecting telescope to pick up and intensify the rays given out by the candle at this distance.

A rough estimate of the total amount of heat received from the stars is of interest in this connection as compared with the heat received from the Sun, the latter being of the order of 1.9 gram calories per square centimeter per minute. From tests made on the star "Polaris" it was found that it would require the *total radiations* from that star to fall upon 1 square centimeter for 1,000,000 years in order to raise the temperature of 1 gram of water 1 degree Centigrade. In marked contrast with this figure is the comparison with the radiation from the Sun; in this case the heat falling upon the earth's surface in one minute is sufficient to raise the temperature of 1 gram of water 1 degree Centigrade. Recapitulating, it may be also stated that the radiations from all the stars which at any moment can fall upon 1 square centimeter of the earth's surface is so minute that it would have to be conserved and absorbed continuously for a period of 100 to 200 years in order to raise the temperature of 1 gram of water 1 degree Centigrade. Hence the incoming stellar radiations can contribute to the retarding of the cooling of the earth but little.

(*Continued on page* 522.)



Electrical Apparatus Utilized in Measuring Heat Given Out by Distant Stars. At Left: Eyepiece of Telescope Carrying Glass Tube Containing Sensitive Thermo-Couples. At Right: Sensitive Galvanometer and Protective Iron Shell for Same.

ELECTRICITY RESTORES LIFE IN MOVIE PLAY.

In one of the latest spectacular motion picture productions, known as "Lola" and produced by the World Film Corporation, electricity plays a prominent part, as the photograph here shown portrays. A large static machine may be seen in the background of the picture. This particular photograph was produced by superimposing two other distinct pictures, hence it is really a triplicate print.

The original film production gives a very spectacular and weird effect indeed. The doctor is endeavoring to bring back to life the heroine, known as "Lola" (played by Clara Kimball Young), by passing electric charges into the body through two large-size Geissler tubes held in the hands, as may be observed in the picture. Electricity has made possible some of the very best film plays of a scientific nature, as notably exemplified in the famous "Exploits of Elaine" series, produced by the Pathé Co.

How Electricity Restores Life in Spectacular Film Play, "Lola."

THE ELECTRIC ROLLING CHAIR IS HERE.

The electric rolling chair is here, and by the way it is being patronized one would conclude that it is here to stay. Probably all of the beach resorts of the country of any importance have had rolling chairs of the man-power kind for years, but, so far as known, this is the first instance in which electricity has been brought into play in connection with this feature.

This new kind of "jitney bus," which has just made its appearance in Venice, Cal., is operated between that city and Ocean Park, a mile distant. Between these points a wide cement walk runs along the ocean front, providing an ocean view for the occupants of the car all the way.

Venice, Cal., Boasts an Electric Rolling Chair. It Holds 18 Passengers and the Fare Is a "Jitney."

This car is about 12 feet in length and has a capacity of 18 passengers in addition to the driver. It is operated by a single employe, the practise being to stop the car midway between the two cities and collect the fares. It is impelled by a motor of two-horse capacity and is capable of maintaining a speed ranging from four to 10 miles an hour. The current for the motor is obtained from storage batteries placed under the seat. As may be seen, a "jitney" is charged per ride between these cities.—*Photo by Albert Marple.*

ATLANTIC AND PACIFIC DINERS LINKED BY WIRE.

Communication by telephone between New York and San Francisco was held, without a break, for an hour recently, when members of the Rotary Club, who dined at the Hotel McAlpin, New York, talked with their friends who were holding a dinner on the 'Frisco Exposition grounds. The long talk was arranged by the New York Telephone Co., and several of the officials were present, including Belvidere Brooks, the general manager, who had a seat at the speakers' table.

The voices in San Francisco were heard distinctly, and members of the club in New York recognized their friends.

There were 450 at the dinner at the McAlpin, and everybody heard the conversations, as individual telephones had been connected with the tables. They heard also opera selections played in San Francisco on a phonograph. H. E. McClusky, a member of the Metropolitan Opera Co., who was at the McAlpin dinner, then sang for the benefit of the members of the San Francisco club. There was no doubt that they heard each word distinctly, for the applause was tremendous.

NEW ARMY FIELD TELEPHONE AND BUZZER DEVELOPED BY THE U. S. SIGNAL CORPS.

For military signaling requirements a most important device is the buzzer telegraph and telephone apparatus used by the Signal Corps Division of the Army. Uncle Sam's boys have lately developed a new instrument along this line which is shown in the illustrations herewith. It is known as the camp telephone, and the auxiliary apparatus which goes with the set is termed a service buzzer. The principal duty of the buzzer, which is specially constructed for the work, is to produce high-pitched telegraphic signals which may be carried over several miles of ordinary conductor. Besides such a signal can be heard, even when the line is broken in one or more places, as has been frequently found in tests made with this apparatus, or also when the line becomes short-circuited for some reason.

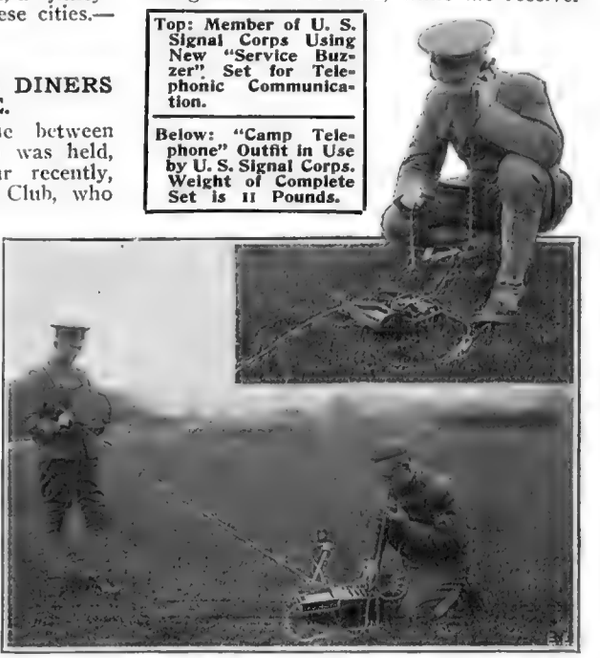
The camp telephone set is being distributed to the troops of the regular army at this time and supersedes the old field telephone outfit of the portable type. It may be used in any location and works remarkably well, indeed. The complete apparatus is enclosed in a rugged and serviceable folding case, weighing approximately 11 pounds. The instrument is of the local battery type and a small two-cell dry battery, such as those used in tubular flashlamps, supplies the current for the talking circuit.

The buzzer telegraph instrument may be utilized as a telephone set when necessary, but if the line should become severed, or if for any other reason, it may then be employed to transmit regular telegraph signals either by Morse or Continental code.

In the large illustration a member of the United States Signal Corps is shown using the camp telephone set, while one of the men holds the reel of flexible conductor used in running the line between two stations. The smaller picture shows the new service buzzer utilized for telephonic communication; the microphone of the set being held in the hand, while the receiver is pressed to the ear of the operator, as in using the regular telephone.

Top: Member of U. S. Signal Corps Using New "Service Buzzer" Set for Telephonic Communication.

Below: "Camp Telephone" Outfit in Use by U. S. Signal Corps. Weight of Complete Set is 11 Pounds.



The housewife walks a mile in an ordinary day's ironing—buy her an electric iron and curtail this unnecessary labor.

The Poniatowski Ray

By George Frederic Stratton

BY the San Elota water-hole on the parched Apirachie Desert the small party of United States troopers were camped, the coatless—some shirtless—men sprawling and gasping while the picketed horses stamped and grunted miserably.

"Mojave Desert is some refrigerator to this!" grunted Dyke Harkin. "All th' same if it wasn't so cussed hot there'd sure be a picnic in this campaign. Four hundred U. S. troopers meanderin' a couple of hundred miles into the midst of these thousands of little Japs an' Chinese an' Mexicans! And never hearin' a yelp!"

"They yelped enough up there on the Rio Grande to carry all over little ole Mexico," chuckled Rickards. "That's when that Nullifier got over 'em and set 'em floatin' real aimless an' disregardful. They sure smeared all over the horizon!"

"And they sure yelled!" broke in Luke Summers. "I was in the old Whiskey Slide mining camp in its toughest days, and heard language, all right, but what you'd heard there was Sunday-school talk 'gainst the saints and devils those Mexicans hollered for when they were bucking each other 40 or 50 feet above the sage-brush. It was simply scand'lous, whatever that might be."

"I reckon they haven't got over it yet," grinned Harkin. "They don't seem to be dead anxious to get where we can invite 'em in for a smoke or a poker hand. This is more like a moving picture stunt than a campaign. Look at them guns—big enough to scare the gall out of a million of men, an' yet—well, you know what they are!"

He waved his cigarette over toward the battery of six guns, appalling in their monstrous length and diameter. As large as 16-inch turret guns, they were mounted on ordinary wagon gears, and although on the march a dozen mules were hitched to each, it was to emphasize the size. Four would have been ample even on bad grades, for they were but wooden counterfeits—all except one.

A laugh broke from the party. "Bob-tailed flushes—every one of 'em!" grunted Summers. "But they've sure got the enemy guessing if their aero scouts have sized 'em up."

"There's one of 'em 'll do something to 'em besides guessing!" grunted Rickards. "That aluminum gun there that looks like the others, only it's different. Four men can dismount that easy an' carry it up any trail that a mule could scramble over. That fellow Cawthorne's had a hand in that!"

"Well, say! Who's this Cawthorne, anyway?" asked Stull.

"He's the son of his father," grunted Rickards.

Stull glared, spat viciously at a cactus, and growled:

"You've got me! I pass! Now, who's his father?"

"Dunno. He's dead! But he was the high monkey-monk of the biggest electric factory in our ole United States; and his son's following in his footsteps—more or less."

"Ugh! An inventor, eh?"

"Nix! He's not an inventor himself, but he antes-up for 'em. He built those submarines that put all the Jap-Chinese battleships to sleep up San Francisco way. Likewise an' also, he got up those Gravitation Nullifiers we've been tellin' you about. An' when you hear that he's got a hand in one of those big four-flush guns, you can look for some play."

From out of the rosy glare of the setting sun a scout aeroplane came over the camp and circled slowly round.

"Signaling the Colonel!" exclaimed Harkin, and a moment later a bugle sounded. It was not a regulation army call; the men recognized it as the special call for Captain Cawthorne's squad, and instantly every man in the camp was on his feet gazing at the group of men who rushed to one of the big guns.

Captain Cawthorne and Lieutenant Sandhurst strode over to the great aluminum tube. A command was given and the muzzle of the gun went up in the air until it pointed to the zenith. Then it was lowered and pointed to the horizon.

"Circle it!" commanded Cawthorne.

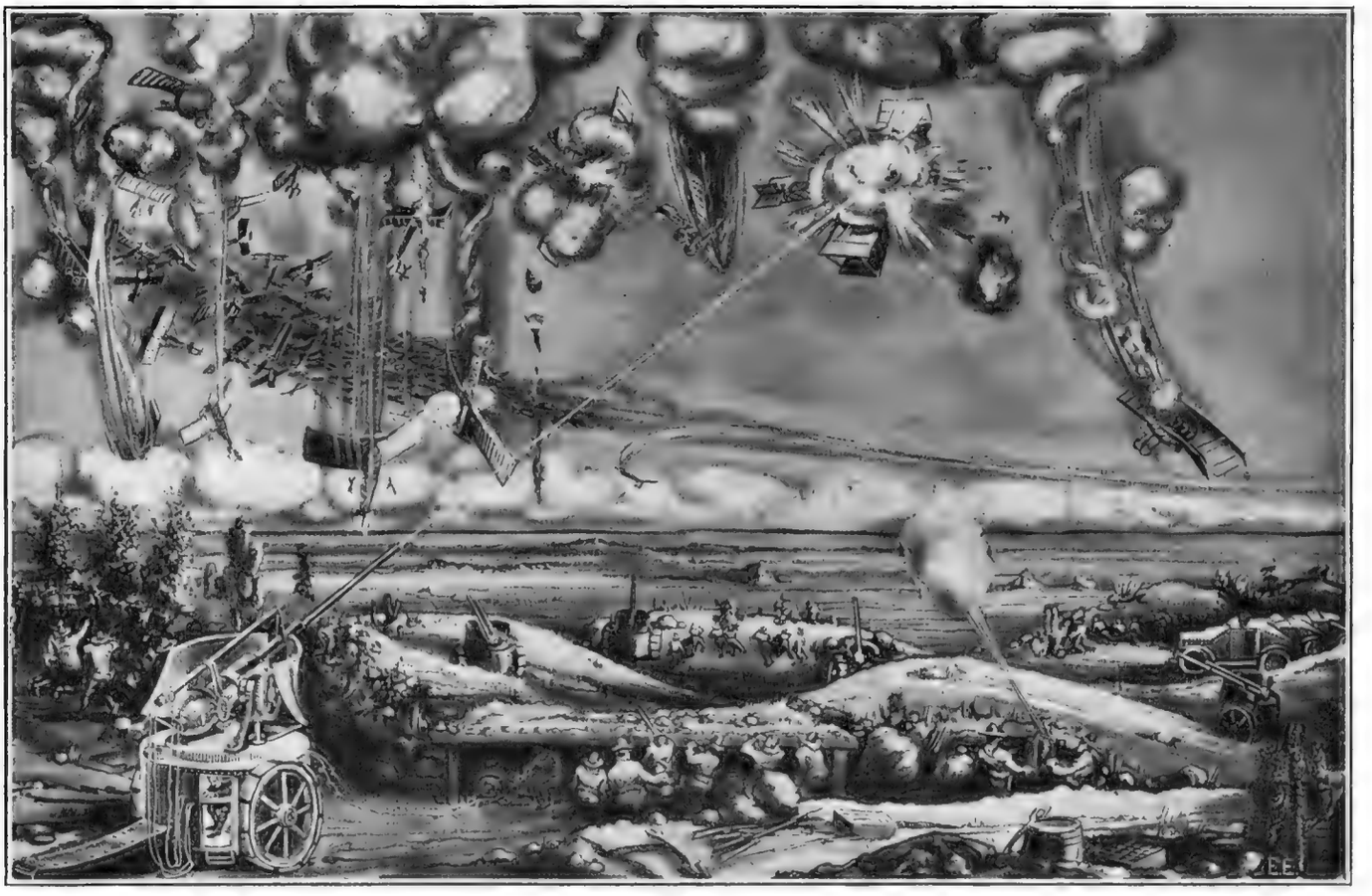
The great tube swept swiftly round in a complete circle, and Cawthorne murmured: "In fine control, Lieutenant, and just in time. Here they come!"

Southward was the buzz as of the steady hum of many factory wheels, but nothing could be seen.

"The connections with the producer are all right, Kilroth?"

"All right, Captain. I've turned on the radio selenite plates and the accumulator."

Then in the south appeared a blur like nebulae of a gray cloud. The burr increased and in less than a minute the enemy reported by the scout aero became clearly



"Captain Cawthorne swung the tube across the sky . . . . . and that ray—the marvelous 'Poniatowski ray'—fired every bomb, every gun and every holstered revolver among them."

IF you are at all interested in the wonders of modern science, you will surely appreciate this remarkable story by Mr. Stratton. The Poniatowski Ray, which proves to be the medium whereby the American army annihilates an entire hostile aerial squadron, is believed by many to be a future scientific possibility and one that may become a practical device for military uses within a shorter time than one may suspect. Briefly considered, the Poniatowski Ray may be visualized to consist of a powerful ionized stream of electrons which can be shot forth from a proper directing orifice or tube, in a practically parallel stream, vibrating at millions of cycles a second and capable of detonating any kind of explosive, no matter how well it is protected by external casings. The latest scientific theories advanced endeavor to prove that there really is no solid matter existent, but that what we term matter is made up of electrons electrically related or bonded to each other under certain conditions which obtain in nature. If the key to this situation is discovered, as for instance, is exemplified in the Poniatowski Ray, then indeed the war of the future will be a catastrophous world-wide event unbelievable and we might almost say unimaginable.

visible—a great, scattered mass of aeroplanes.

"They're planning to clean us up," grinned Cawthorne. "I suppose every one of them carries bombs, but they little dream who's going to give the order to fire 'em."

"They're three or four miles off yet," muttered the Lieutenant. His binoculars were at his eyes, and after a steady look he said: "There must be three or four score of them, Captain."

"Put that rapid-fire gun into action!" commanded Cawthorne. "Never mind the aim; just make noise." Then he sprang to the sighting instrument of the projecting tube and pointed it at the approaching aeros.

"Switch in, Kilroth!" he exclaimed.

Instantly a tiny ray of light, so nearly as blue as the sky as to be barely discernible, shot from the tube, and from the aero fleet, a mile away and nearly a mile above the earth, came lightning flashes of flame with terrific crashes, drowning out the continuous rattle of the rapid-fire gun. Cawthorne swung the tube across the sky with some little deviation in the elevation, and that ray—the marvelous *Poniatowski Ray*—fired every bomb, every gun and every holstered revolver among them. The gasoline tanks went as instantly, wrecking the aeroplanes. Even the few which had not been caught in the first sweep of the ray and had circled round or to one side, were caught by the swift, well-judged movement of the projector. Within one minute that fleet of over 80 aeroplanes had come to the earth, most of them smashed to splinters by their own explosions, the others crippled by the near-by concussions or collisions.

"Good work!" exclaimed the Lieutenant. "We've put every one of them out of commission in less than half a minute. Hello! What's that mean?"

A shrill bugle call rang out, "Saddle-up," and all the men of the command were instantly on the jump. Colonel Rutherford, who was in general command of the expedition, strode up to Cawthorne.

"That's simply miraculous work, Captain; but it breaks up this night's camp. We're 40 miles yet from the coast, and we must cover that before the enemy has time to figure out how to meet this astounding attack. One plane got away and will report it all."

"I think they'll lay it all to that rapid-fire gun, Colonel. That ray was scarcely visible to anyone not looking especially for it, and of course they don't know of the existence of such a thing."

"Possibly so, sir. But I wish it hadn't been necessary to use it at all until we could open up on their vessels. Well, we'll advance now, so as to make our main attack to-morrow night."

An hour later, as the officers were butting their armored car through the sagebrush and talking over the instantaneous demolition of the aero fleet, Lieutenant Baxter asked:

"Who is this man Poniatowski who discovered, or invented, that ray, Captain?"

"Discovery is right," smiled Cawthorne, "although I'm sure from what he told me that he used up as much time and intense thought and study in reaching that discovery as if it had been the most intricate invention. He's a Pole and was a man of property over there, and very scientific attainments, but after he had discovered that extraordinary arc—and in spite of his efforts to keep it secret—his Government, with its spies at every man's elbow, heard about it and demanded a full description of its principles and application. They had even ordered his arrest, when a friend gave him a pointer. He smashed his apparatus in his home workshop, secured the gram of radium in which all his wealth—nearly a hundred thousand dollars—was tied up, and fled inside of an hour. He had thrilling adventures and hair-breadth escapes, but reached a port and got passage to this country. But in that struggle for freedom—for life—he lost that radium and landed in New York in poverty. He got a job as laborer in our shops, and I heard of him through one of the foremen and got in touch with him. When he found that I was surely a friend he told me about the arc. That's how it is."

"And you went ahead and developed it?"

"I helped in the only way I can help with such things—by money. I sent him to my experimental shop at my country home, bought another gram of radium and put everything at his disposal."

"And this is the first time the ray has ever been put to use?"

"Absolutely! Poniatowski is no lover of warfare. The fearful calamities of it in his own country made him determined to put no fresh weapon in the oppressors' hands; but, all the same, he sees plainly that, used for defense or repression, it will stop warfare with one-quarter or one-tenth of the sacrifices of life and property of the most deadly up-to-date implements now in use, for it puts the fighting all on one side. It puts the enemy's forces—land or naval—absolutely under the control of our officers, as you will see to-morrow."

"I've seen it to-night!" muttered the Lieutenant grimly. Then, after a pause: "I presume then, Captain, that the projector we have with us is the only one in existence?"

"No; there's another. I built this one at my own expense and offered it to the Government. When they decided on this expedition they planned to have another for a relief machine. Then a dispute came up as to which branch of the service the projectors properly belonged to—the army or navy—and they discussed that for three weeks, and settled it by ordering one projector to be placed on a cruiser and sent round to the Gulf of California to Admiral Roberts' fleet, and the other one to be sent overland to attack the Allies' headquarters at Zapata. You see, Admiral Roberts cannot take his ships into the bay because those Japs have mined and netted the entrance thoroughly, and their submarines prevent all efforts to clear the channel; but if they put that projector in action it will explode every mine and every submarine within reach of the ray, and we've tested that up to six miles."

"What! That marvelous ray can operate under water? Can find and explode the hidden mines?"

"The tests have shown that thoroughly, Lieutenant."

The end of that forced night march took them within 16 miles of Zapata, on the shore of the Cisneros Bay in the Gulf of California. Here was the supply base of the allied Mexicans, Japs and Chinese, the latter two furnishing from their great fleet of transports and supply vessels the munitions which the Mexicans were deficient in, their supply from the United States being, of course, shut off.

A scout aero came in and reported that the enemy had cut a trench five miles from where Rutherford's command was, and had an immense body of men excavating a second trench between the first and Zapata. As that report was made, firing from the first trench commenced, and shells began to drop, although the range and the aim were inaccurate.

"We've got them guessing pretty bad, if not scared," laughed Cawthorne. "Digging trenches to protect 20,000 men from 400! Those Gravitation Nullifiers aren't forgotten yet, and the mysterious explosions of their aero fleet haven't quieted their nerves any."

"Send an order back to our aeroplanes to advance immediately with the two Gravitation Nullifiers!" commanded the Colonel.

The crews of the aeros were bivouacing five miles in the rear, but in 10 minutes they were flying swiftly over the command, one of them coming to the ground to pick up Cawthorne.

From the first trench came volleys of shot and shell, but the aeros had risen 3,500 feet, and no missile reached them. Then the little bullet-like metallic *attractors* were scattered from the escort aeros upon the trench below and the Gravitation Nullifiers Nos. 3 and 4 went into action.

The gravitation of everything below them instantly disappeared. Heavy guns, being fired as the Nullifier influence reached them, recoiled as if they had themselves been struck by a 10 times larger shot than they had fired. Japs and Chinese floated out of the trench clutching frantically at each other or at the wafting cannon or small arms with which they were mixed.

So on to the second trench, where men with picks and shovels found their weight gone; where boulders which two men with difficulty tossed out of the trench suddenly lost the earth's attraction and drifted away in utter aimlessness. Mules hitched to ammunition and supply wagons, frenzied by the astounding conglomerate of men, weapons and rocks which floated against them, pranced into the air and failed to regain any footing. The demoralization was complete.

But from a relief trench guard which was

(*Continued on page* 518.)

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

Thought Transmission On Mars

I WAS sitting in front of my radio set lost in thought. Yes, perhaps I was dreaming while I blew big gray clouds in the air; you are apt to do so if you are smoking your favorite *Nargileh*—the Turkish water pipe. I personally like the Nargileh, where the smoke must first pass through the water, there to be purified before it enters your mouth, cool and fragrant. If you are a pipe smoker you must get acquainted with the Nargileh by all means, there is nothing quite like it. I am so enthused about it that I would like nothing better than telling you how to make one, but—alas—I am supposed to report Münchhausen's doings; am supposed to be writing fiction, *scientifiction*, to be correct, and not "how-to-make-it" "dope!" The editor says he can get all the contributions he wants for that department, so he doesn't need mine. Between you and I, I like the "how-to-make-it-stuff" better myself. Mars, to be sure, is all right, but we're simply not educated enough to understand all this advanced Martian business. If I could only get a message to Münchhausen and ask him what kind of "dope" is published in the Martian *Electrical Experimenter* in their "How-to-make-it" department! As our venerable friend, Thomas Reed, is wont to say: "Take it from an old bug, that would be a treat, eh, buglets!"

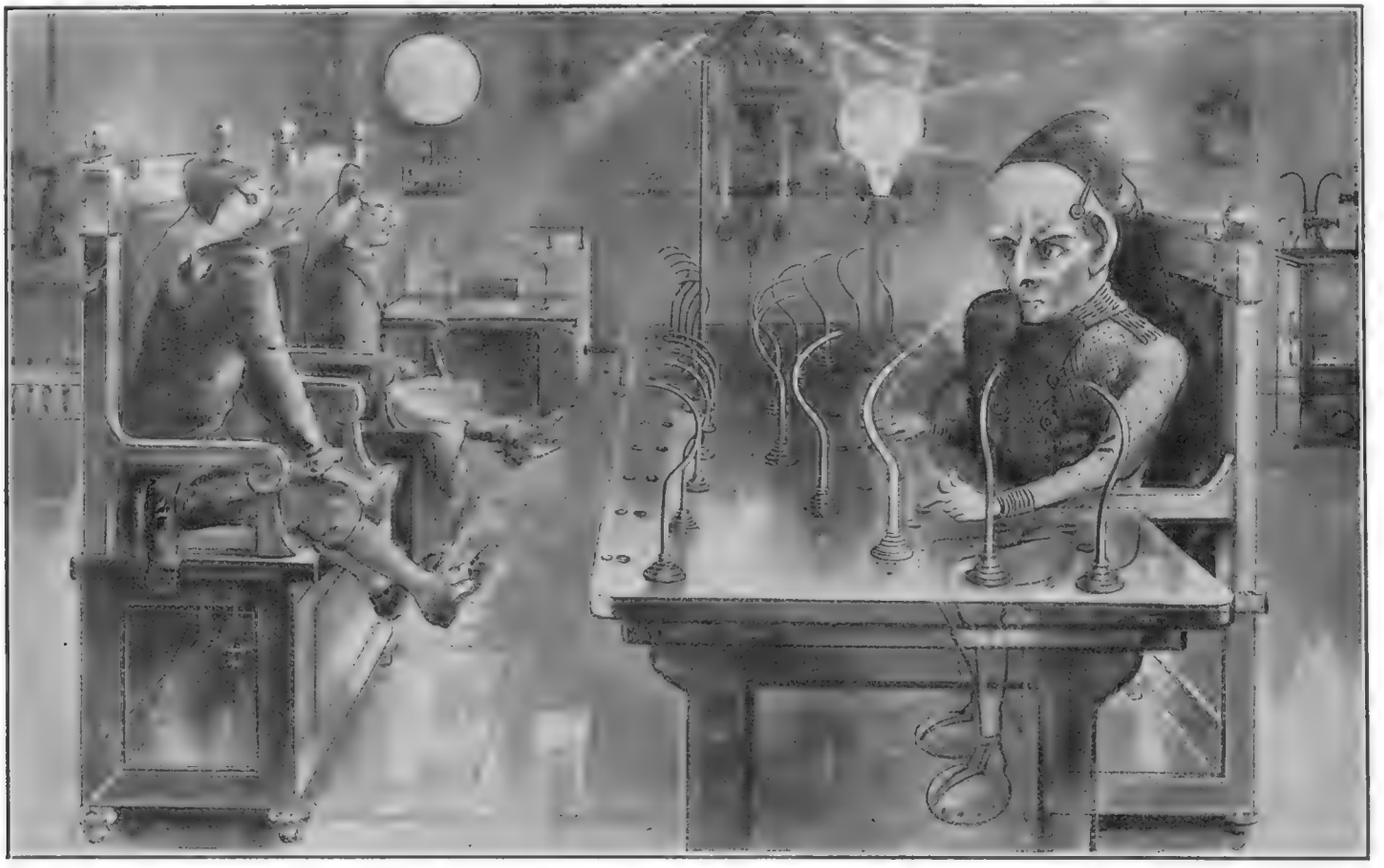
I was still dreaming, lost completely in a blue smoke cloud when my electric chime, controlled by the Western Union clock, which gets the exact time hourly from the Naval Observatory, commenced to sound the eleventh hour in its sonorous, vibrant voice.

At the stroke of eleven—my headset had been already clamped over my ears—the familiar high whistling sound sung in my ears once more. Punctually, as usual, Münchhausen "called."

"Same, good old Münchhausen," I said to myself, and I listened expectantly for that dear, croaking sepulchral voice. Instead of this, however, he had a little surprise for me. He did not speak; instead, without warning, there suddenly broke into my ears the most amazing music a mortal has ever heard. The sound was so loud that I was actually forced to take the 'phones from my head and place them on the table, and I had to go to the far end of my laboratory in order to hear the music at its best.

And to think that I was listening to music which had originated on Mars 60 million miles away! It was almost unbelievable! However, there it was, filling up the entire room with the most delightful music, impossible to describe. Sometimes it sounded like an immense orchestra, then again like a *celesta* instrument. At other times the music sounded like a 'cello mixed with a flute, immediately to change into a mixture of an oboe and a cornet. In between there was a sound like human singing, but altogether different in quality and volume. Moreover, all sounds were sustained, never to break off sharply; and the music from one instrument seemed to melt into that of another without the slightest break. Thus imagine, if you can, that you are listening to a violin which gradually, in a most harmonious manner, changes into a cornet without a break! What I heard is absolutely impossible to describe adequately, for you can't describe music on paper. I can only say that I had never been stirred so deeply by music in my life, and I have listened to exquisite music in my days.

For five minutes or more I listened entranced, when the music gradually died down to a plaintive, almost crying, sound which almost brought tears to my eyes. When the "concert" was over I returned to the 'phones and I had hardly adjusted them when Münchhausen spoke: "Good evening, my dear Alier, how is old Mother Earth and yourself to-night? Sorry you can't tell me, at any rate I trust all is well! I hope you enjoyed my little musicale, there has never been *such* music on earth, to my knowledge. Too bad the telegraphone wire to the moon is so short, otherwise I would have given you a longer program. At any rate, I am certain you liked my little concert. Of course, now that you have heard Martian music you would like to know how it is produced. If I were not so far famed for my veracity I should certainly run the risk of being called something less well sounding than a story teller, but I know you will not question my statements. The undisputable facts are that the music which you just heard was produced from a solid transparent *Tos* rod, about ¼ inch thick and almost 8 feet high. At each end of this rod there is a coil which looks like a big terrestrial magnet coil. It has, however, about 14 distinct



"* * * * * the Ruler of the Planet Mars Was 'Reading' His Morning Correspondence."

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and separate windings. The ends of these windings go to a sort of switchboard which has a triple keyboard like an organ, and both coils are connected to this organ-like instrument. By depressing a key a certain pulsating current is sent through one of the coils. This in turn sets up Eddy currents in the Tos rod, which is, of course, conductive. These stresses in the rod set up vibrations and cause the rod to swing like a piano string—sound is the result. By using different frequencies different sounds are produced. When both coils are operated at the same time interferences take place within the rod, causing the sound to change in its quality. Thus by operating the two coils while changing the current intensity and by using different amplitudes, most every imaginable as well as unimaginable sound can be obtained. It is thus easy to imitate a cornet or a xylophone in their true musical values. Nor is this all, for the rod can be made to sing and trill, and it can be made to actually speak words; a good player is able to imitate the spoken or the singing voice of any living Martian equally as well as a lifeless, black phonograph disc on earth, can be made to sing the most difficult aria.

Nor does the wonder stop here. By using a sufficient amount of power the sounds can be intensified to such a degree that music emanating from a Tos rod can be heard plainly over a distance of 10 miles. Indeed, all outdoor concerts on Mars are given by means of a single Tos rod. In only one case have I seen two rods being operated simultaneously. The effect in this instance was overwhelming; it was like listening to a thousand-man orchestra and to a dozen tenors all going at one time.

But this is not all. You know that if a rod is vibrated at a sufficient frequency it will sound a certain note. The faster it vibrates the higher the note will be. If we keep on increasing the speed or vibration we finally arrive at a stage where the note is so high that the human ear is no longer capable of hearing it. If we keep on increasing the frequency, higher and higher, a stage is finally reached where the rod sends out waves that have the velocity of light and electricity—186,000 miles a second. This, of course, is well known to your physicists on earth.

Now, then, it is this principle that the Martians make use of in supplying the music loving people of Mars with wireless concerts. The operation is simple indeed.

Not far from the equator of the planet a central music plant is operated by a single Martian, who, of course, is a musical genius. He operates one of the organ-like instruments of which I spoke before. The "plant" comprises besides the instrument, two Tos rods each 20 feet high. These rods work exactly as the ones just described, except that they are operated at an enormous frequency. I have stood in front of them while they were operating, so close, in fact, that I could have touched both rods with my hands. However, my ears detected not the slightest sound. But, incredible as it seems, millions of Martians were listening to the wonderful music at that minute, produced by these same rods, *but not with their ears.* They were listening with their brains!

I told you a few days ago, how, when we first landed on Mars, we had been amazed to "hear" snatches of a wonderful music inside of our heads. What we had been hearing was the wireless music originating from these two Tos rods some 2,000 miles distant! Of course, wireless music is nothing new; the sounds of voices and music having been wafted over thousands of miles on earth already, but your scientists still require huge aerial wires with which to catch the waves. And these waves are, of course, not audible themselves to our ears. You are still using a variety of coils, detectors, telephone receivers and

OUR scientists of to-day as a rule ridicule any attempt of thought transmission and not without good reason, for there does not seem to exist any authentic case on record where thoughts have actually been transmitted freely between two individuals. But, in view of the fact that during the last 20 years we have learned how to transmit wireless impulses through the ether without the use of intervening wires, is it not possible to conceive that given sufficiently sensitive apparatus we will some day find it possible to transmit our thoughts through free space? Baron Münchhausen throws a new light upon this fascinating problem. We are confident that you will enjoy this instalment.

what not in order to translate these wireless waves into sound waves in order that your ear may hear them.

Not so on Mars. Every Martian is required, for reasons which you will understand presently, to wear a peculiar soft metallic cap. From the back of the latter a thin metallic cable runs down the Martian's back and is fastened there to his metallic coat. All Martian clothing, as well as footgear, is invariably of metallic weave. Now as all pavements and all flooring, carpets, as well as rugs, are metallic on Mars, for reasons which will be apparent to you later, a metallic connection with the earth or "ground" is always effected.

The metallic cable of which I just spoke does not make contact with the cap itself, but it is insulated therefrom. It connects, however, with a small reddish metallic plate about the size of an American silver dollar. This plate in turn, by means of a flat spring, presses against the temple of the wearer; the cap itself holds the plate in place. A similar plate presses against the other temple, but this plate, unlike the other, is connected metallicly to the cap itself. From this description you will gather that the metallic cap performs the function of a wireless aerial, while the metallic clothing forms the ground. The two reddish plates pressing against the bare temples are made of two metals unknown on earth, and the metals are distributed over the surface of the plate in honeycomb fashion without touching each other. Now if the two plates are pressed against the temples and when wireless waves are passing through them, the waves are translated into vibrations of a certain frequency. It has been found that if these vibrations reach the conscious sense of hearing which is located in the *Temporal Lobe* of the brain, sounds can be impressed upon the brain without requiring the ear and its auditory nerve. In other words, the sound is "heard" directly within the brain without the agency of the ear's mechanism.

If this should be somewhat hazy to you a homely (though inaccurate) illustration will not be amiss here. At first blush one would think that the ear is absolutely essential for hearing, but this is not the case. Try the following simple experiment: Stop up both your ears as tightly as possible with cotton so that you will not hear a sound from outside. If you are partly deaf—and I trust you are not—all the better for the experiment. Place a darning needle between your teeth by biting on it hard and take care that your lips do not touch the needle. The needle itself should project about 1 inch from your mouth. Now operate an ordinary disc phonograph and with care press down upon the record with the needle's point held at the same angle as the reproducer's needle is held ordinarily. Your whole brain will be filled immediately with music, exceedingly loud and clear. Of course, in this case you still hear with your ear's mechanism, the sound vibrations being carried to the eardrum through the bones of the head; but it is interesting to note that if a truly deaf person tries the experiment he will be enabled to "sense" the sounds, although not perfectly.

Of course, the function of the Martian apparatus is based on an entirely different principle, and the above experiment is only cited by way of comparison.

It goes without saying that these little red honeycombed plates, pressing against the temples are wonderfully sensitive to etheric waves; in that they exceed enormously the most sensitive wireless detector ever invented by your scientists. But not only do these wonderful temple plates serve to bring distant music to the Martian's brain, but they still have a more important function. The fact was already mentioned to you how we first made our acquaintance with thought transmission and how we found it impossible to transfer thoughts without the caps being on our heads.

The act of thinking, as we know it and as has been understood on earth for a long time, is merely the action of certain nerves stimulating certain brain centers. The harder we think the stronger the stimulation. This stimulation in turn sets up an undulatory motion in the effected brain cells, with the result that these cells must of necessity vibrate like a piano wire. But anything that vibrates—no matter what the frequency—must set up waves. Thus we come to the conclusion that the act of thinking must set up certain waves. Now if we can find a medium by which it is possible to detect these waves it becomes as simple a matter of transmitting the thought waves as any other wave.

The medium of detecting these "brain-waves" is found in the Martian temple plates, enormously sensitive to the brain's short wave lengths. But not only do these composite metal temple plates detect the "brain-waves," but they translate them directly into a longer etheric wave length, which in turn is shot out into space similar to a wireless message. While these waves are fairly strong, their intensity is not sufficient to carry them over great distances. As a matter of fact, thoughts have only been transmitted for a distance equaling about 10 terrestrial miles on Mars. And even this was exceptional, extra high sensitive apparatus being used at the time for the experiments. As a rule the Martians do not project their thoughts over 50 terrestrial yards, as the confusion and clashing of the many waves would otherwise become too great. If a number of Martians are assembled in one room they can converse very nicely by thought transmission without interfering with one another.

(*Continued on page* 523.)

How "Wireless Wiz" Welcomed the New Year

By Thomas Benson

I WAS sleepy that night as I sat "listening in" at my wireless to N.A.A. shooting code stuff, and it seemed a sort of dream when about 11 o'clock I heard the "Wiz" break in. His spark note rose rapidly as the rotary gap picked up, and he began to rattle the ether with my call. I O. K.'d him and took down: "Say, old man, I just finished doping out a cracker-jack party for New Year's; come over to-morrow and help me install the junk, will you?"

"Sure!!"—and my spark seemed to wink at me as much as to say: "Some party, fellow," as I pounded the key in reply. "I was wondering why you called so late," I added.

"Oh, I had some battle getting all this arranged, but it will be worth it; now don't forget, come over early!" His code was shaky in spots, and I could imagine him laughing to himself as he handled the lightning, for I knew the "Wiz" of old; the "Wireless Wizard" the neighbors called him.

* * * * * * * *

"Oh! Tom, I'm getting frightened," whispered a trembling voice in my ear as the eventful evening came and we were approaching the Wizard's home. "I'm really afraid of Jim and the tricks he plays on us."

"Too late to think of that, girlie," I replied, reassured by my knowledge of the surprises awaiting us, and I held her the least bit tighter and told her to keep her nerve up, for the male of the species is always courageous when he knows what's coming off!

We mounted the steps and rang the bell. Suddenly, as if by magic, there appeared in letters of fire on the door: "ENTER, YE OF BOLD HEART." Then slowly and mysteriously it swung open.

With a much-scared girl on my arm, I walked into the hall. It was a masked party, and the "Wiz" stepped forward, garbed as Satan, to meet us; and as he led me up to the cloakroom I noted that he seemed to be a living flame, for he was glowing like fire. Most of the others were already there, and it was a great sight to see a *bearded pirate* discussing the heterodyne receiver with *George Washington*, a *straw-chewing farmer* showing the latest fancy steps to an *African chieftain*.

After removing my coat and hat and standing forth as a Spanish bull fighter, I looked around for the "Wiz," who then led us to the Altar of Mystery, in the Chapel of Spirit Worship.

That room was certainly "classy," with its cornshocks, which stood around it on a floor that shone like glass. Imitation logs were arranged along the wall for seats, and the ceiling was draped in a flimsy gray cloth, through which glimmered the light from numerous concealed red and yellow electric bulbs. The girls waiting for the dance seemed like fairies in the dull, soft glow of this cleverly arranged grotto.

A piano started to play somewhere, and as the dancers swayed to the sound of the latest music the notes seemed to come from nowhere in particular. At times it seemed as though the piano was in the basement; at others overhead, in one corner, then another, and everywhere at once.

It was a smiling crowd that retired to the rustic seats after the music stopped, and they waited with unconcealed expectation for the next move. I was watching the silver lemonade pitcher that was tempting me, but I knew better than to attempt to drink any. An unsuspecting guest finally strolled over and seized the ladle. "Ouch! Wow!" and he staggered back 'mid the laughter of the rest. He decided then that he'd forego the lemonade.

The "Wiz" then dragged a tub of water to the middle of the room and tossed in a couple of apples, and the girls started to bob for them. The apples appeared to possess real life, for when approached they would suddenly sink to the bottom only to fly to the surface again. At times they would spin rapidly. The astonishment occasioned by their antics was shared in by all. Then the music started again and the tub was removed as the dancers glided away.

Next the "Wiz" stepped to the center of the room with a hand full of fans and a large balloon. He blew a whistle and instantly the lights were extinguished, and it was a wonderful sight as he stood there with the fans and balloon glowing in the light from the geissler tubes that shed their variegated colors about us.

Two hoops glowed on the walls at both ends of the room and the "Wiz" handed

". . . . . At the Last Stroke of Twelve Bedlam Broke Loose! A Fire Gong Started to Ring, Whistles Were Blowing, and the Centre-Piece Exploded."

the fans around and started a game of aero tennis. The party were divided into two teams and each endeavored to blow the balloon through their opponent's hoop. The game was getting exciting with the score tied, when supper was announced.

The doors were thrown open and the guests gaily tripped into the dining room. Here the "Wiz" had quite ontdone himself. The table was decorated with miniature pumpkin heads, electrically lighted, and geissler tubes glowed at every plate. The place cards gave forth a weird phosphorescent glow.

The feast went gaily on without incident; as a lull before the storm. Nothing happened till a clock struck twelve.

At the last stroke bedlam broke loose! A fire gong started to ring, the lights went out, whistles were blowing, the centerpiece exploded—throwing the flowers in all directions. Red and green lights blazed forth in all corners of the room.

The figures "1916" stood out in relief on the shirt bosom of the "Wiz."

Then all was quiet. Suddenly mysterious rappings began to be heard, which seemed to be coming from the table. "Hark," muttered a sepulchral voice, "I, the Spirit of the NEW YEAR am here to do your bidding. I am ready to answer your questions."

One after another we all asked questions, the answers following immediately, and they were tinged with not a little sarcasm that kept the crowd in roars of laughter. I smiled to myself as I noticed the strained look on the Wizard's face as he talked under his breath. He had a microphone fastened to his *chest*, and was answering the questions as fast as they came.

Tiring of this we returned to the parlor, where the music had started again.

"Now," announced the "Wiz" amid many Ha! Ha's! and Tee-Hee's! on the part of the girls, "I am going to show each lady present her future husband," and he led them one at a time into a small room decorated like a cave. In the center burned a charcoal brazier on which he tossed dead leaves, a little incense and a hair from the girl's head. He stood over this muttering incantations. Slowly but surely a face took form in the vapor arising from the fire.

After each overawed, shivering girl had seen her future mate the music struck up "Home, Sweet Home," and the guests prepared to leave.

It was a merry crowd that prepared to leave the "Wiz" that evening, and as the guests were passing out the front door a mysterious gust of air blew their hats off and sent them helter-skelter down the street after them.

After the adieus were spoken and as they started home they were enveloped in a flood of white light from the Wizard's powerful electric searchlight mounted on the roof, and I can still see them as they disappeared from sight with their varicolored suits and the tinkle of bells on their costumes.

I had stayed to say a few words to the "Wiz," and as he came into the room he sank into a chair with a sigh, looking tired and as glum as an owl.

"What's the matter, Jim?" I asked, "we had some time to-night, cheer up!"

He looked at me in such a pitying way I couldn't help smiling.

"Yes," said he, "but do you realize it is a whole year till next New Years. I'm going to bed. Good night!!"

THE MODUS OPERANDI.

It was several days later before I saw the "Wiz," surrounded by a crowd of youths at the headquarters of the *Gee-Whiz Wireless Association*. They were firing questions right and left and he was at his wits' end to answer them. "Go easy boys," he fairly shouted. "I will send you all a blue-print of how it was done; but meanwhile you can look over this hook-up," and he handed them a sheet similar to the drawing we find here. "Yes, sir, but explain!" they replied simultaneously, and the "Wiz" tackled the job without blinking an eyelash.

"It was all very easy," he went on. "The music was supplied by a phonograph in the basement and four loud-talking telephone receivers did the rest. These were connected up to a commutator and a motor so that the current could be switched from one to the other automatically, and that explains why the music seemed to change its source continuously. I had a 4-inch spark coil, which supplied the high tension current for the lemonade pitcher and the geissler tubes. The apples in the tub contained short steel cylinders stuck in them; by means of a switch in the corner and a large electro-magnet under the floor I was able to make the apples behave in a mystifying manner.

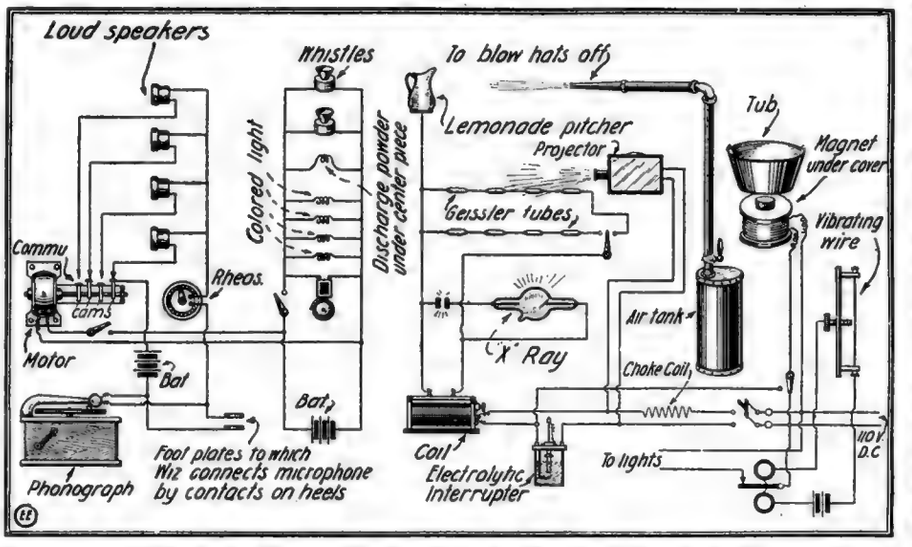
"To extinguish the lights when I blew the whistle I had a tightly strung steel wire tuned to the pitch of my whistle which vibrated, due to the sound waves. This made contact with a fine adjusting screw and operated a relay, thereby extinguishing the lights. As to seeing the faces in the smoke arising from the brazier, that was a cinch. I had a parlor projector concealed behind the draperies and I had a common photograph which was thrown on the smoke, which served as the screen. The girl who saw the picture unconsciously picked out its resemblance to some particular friend of hers and practically kidded herself that he was her future husband, what! The red and green lights around the dining room were easily provided for, as you can well imagine.

"I had a fine wire imbedded in the powder and on closing the switch it was ignited on the table centerpiece. The slight, harmless explosion sent the flowers in all directions and a gong and two whistles completed the noise manufacturing equipment. A nozzle connected to my blow pipe compressed air tank served to blow your hats off as you were going out the door."

"Yes, sir," a wise one among them asked, "but explain that lettering on the front door." "Sodium Tungstate," was the curt reply, "and an X-ray tube concealed on the ceiling served to make a glow when I closed the proper switch. I also used this chemical to write the place cards; to cover the balloon and fans, and I furthermore had quite a large amount of it smeared on my costume.

"The figures '1916' on my shirt front were easily arranged by cutting them out of thick black cloth and securing them to the inside of the celluloid bosom by a little glue. A couple of battery lamps placed inside the shirt and fed from a flashlight battery in my pocket did the trick."

"Oh, yes, it's as clear as mud," another one exclaimed, "but how in the name of the seven stars of the constellation were those questions answered by that supposed Spirit?" "Don't you read the *Electrical Experimenter?*" answered the "Wiz." "I got the idea from that article where they described how the aviators communicate by means of microphones strapped on their chests. So I had a delicate telephone transmitter fastened on my chest and by means of two brass plates on my heels I made connection to the loud-talking telephone circuit," and with a parting smile he left them to puzzle out the other details for themselves.



Diagrammatic Lay-Out of the Electrical Novelties Used for New Year's Party by the "Wireless Wiz."

BIRDSBORO, PA., BOY SCOUTS WORK WIRELESS.

Finishing the week of life outdoors, as required by the rules of the organization, the Birdsboro, Pa., Boy Scouts held the last camp of the year at Neiman's Pond, near Laurel Hill Canal locks.

There was a good attendance and Scout Master Charles Brooke, who had charge of the lads, was well pleased with their conduct and the work they did in conformity with the organization regulations.

The camp was situated upon a hilltop, about one-half mile from the canal, the location being selected for the purpose of erecting a high wireless aerial. This was a new and the most interesting feature of the camp. In an hour after reaching the camp site the wireless corps was in communication with Pottstown, League Island and Washington, D. C., and several amateur stations in these places held conversations with Scout Master Brooke, who is a competent operator. The field set of equipment used was found especially serviceable, light and easily portable, also extremely efficient, loud and distinct.

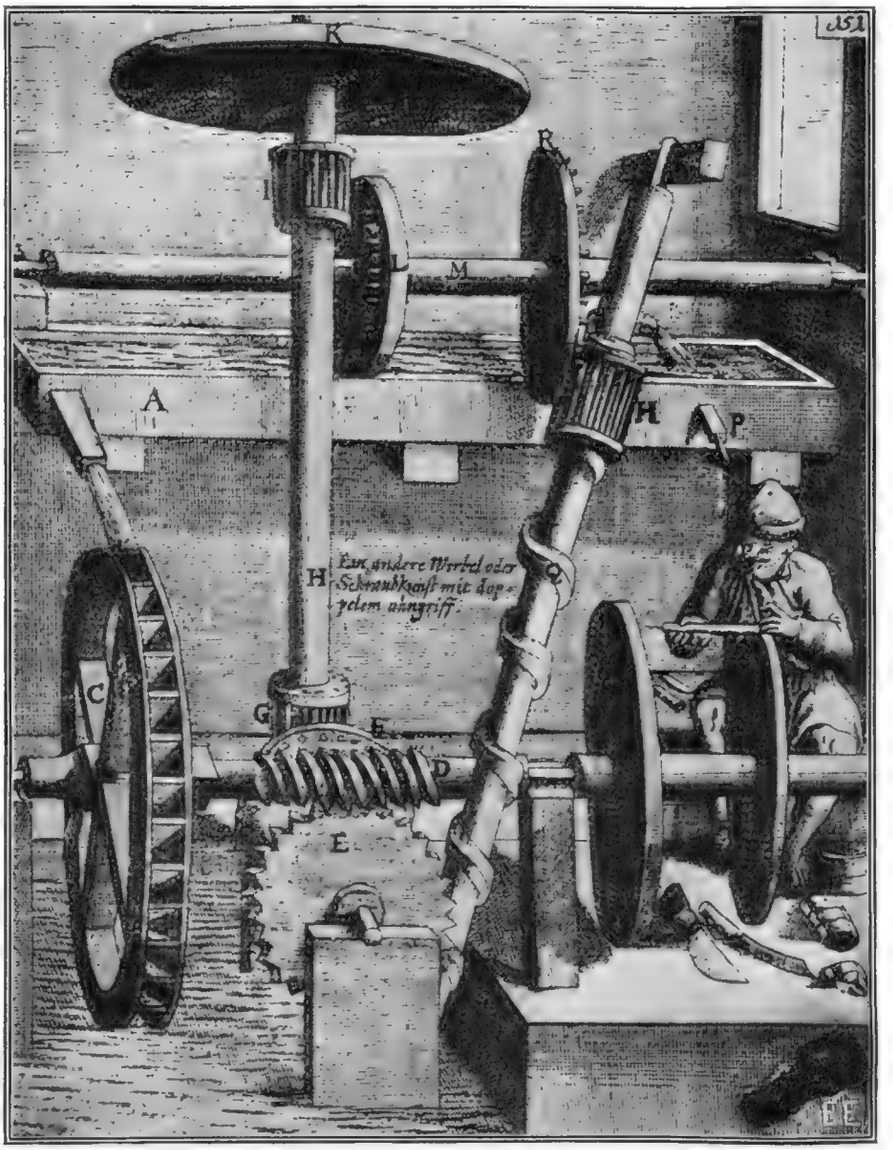
It costs less than 2 cents a week to have this magazine on your desk regularly—may we have the pleasure of entering your subscription.

Perpetual Motion, the Folly of the Ages

By H. Winfield Secor, E.E.

Untold Numbers of Inventors and Even Scientists Have in Years Past, and at the Present Time, Devoted a Vast Amount of Study to the Perfection of a Perpetual Motion Machine—The Problem Remains Unsolved, However, to This Day

PERPETUAL motion is the will-o'-the-wisp that has occupied many brilliant minds in the centuries past, as well as at the present time, and, while we of this age are not entitled, perhaps, to say definitely that all such ideas are absolute folly and baseless from a strictly scientific and physical standpoint, it is pretty thoroughly understood by all well-schooled engineers and inventors of today that there is practically no such thing as *perpetual motion*, in the general sense of the word. Perpetual motion is a very misleading term as applied in various senses, and in treating such a subject as this the confining limits of the points involved should be thoroughly understood. Some theorists and would-be scientists will propose such ideas or phenomena as the light of the sun, ocean waves, rotation of the earth, and what not, as the embodiment of perpetual motion. However, the hundreds, and undoubtedly thousands, of more or less well-trained minds that have endeavored to solve this much-talked-of problem of perpetual motions have invariably had in mind some mechanical, electrical or other machine which, when once started in motion, would continue producing this motion indefinitely, or to the end of time. So far no machine or allied device of any description has been perfected or produced, but several quite remarkable phenomena taking place in nature will be mentioned herein which approach this much-desired goal of inventors past and present.



An old engraving illustrating a "Perpetual Motion" scheme taken from the German work, "Das Perpetuum Mobile," by Andr. Bodler.

This arrangement was supposed to work as follows: The tank of water A discharged through a nozzle on to the water wheel C. This turned the shaft and worm D, likewise the gears E, E, and also the vertical shaft H. Attached to H is a balance wheel K and a pinion I, driving gear L, shaft M and gear wheel R. The latter meshed with the pinion H (at right) secured to the hollow worm Q, thus pumping the water back into tank A. This amazing machine was claimed not only to go on forever, but also to "deliver power," as for driving the grindstone here pictured.

Many extremely amusing situations have occurred between scientists and would-be inventors of perpetual motion machines, and a few of these instances are here cited which may be of more than passing interest to those who have been or who are now thinking along this line.

One of these stories is related of how an inventor of a certain machine betook himself to a mechanical engineer for advice on same. The machine in question was supposed to multiply power and the inventor of this device maintained that if one horsepower of energy was applied to a pulley on one end of the mechanism, then 20 horsepower could be taken from a second pulley placed on the other end of the combination. The engineer asked the inventor if he believed in perpetual motion, and he replied, "Certainly not."

"Well," said the engineer, "if you use one of the 20 horsepower you claim to produce, you will have 19 horsepower left for other work, will you not?"

"Yes," replied the inventor.

"Then take one horsepower from the pulley which will deliver 20 horsepower and drive the other end of the machine requiring but one horsepower, as you mention, and you will then have perpetual motion!"

It is said that the inventor departed forthwith without even unrolling his drawings.

Again, there is nothing wrong with trying to tap any of nature's reservoirs, but what is wrong is when we try to make 2 plus 2 equal 5 mechanically. It is a consoling fact, indeed, that we should know, as we do know, that an accountant's balance sheet is always possible for any mechanical operation. On the one side we have the money paid in, that is the horsepower available; while on the other side we have the money paid out; that is the work done and the energy wasted; the two sides must balance one with the other eventually. For a given horsepower put into a certain device or machine we are entitled to look for a strict accounting of energy expended by this machine. The final results must show so much work done plus so much wasted, avoidably or unavoidably, and the work done plus the work wasted must in every case equal the work originally put in. Also there must be no pretense made or assumed that any amount of the energy has mysteriously disappeared—in other words, there must be no allegation that the books will not balance.

The inventors of so-called perpetual motion machines have, from time immemorial, evinced a partial or total disregard of the basic laws of physics and mechanics. The term "friction," for one thing, seems to have found no place at all in their vocabulary or knowledge of science. If it had, indeed there would never have been patents issued and whole volumes written covering their early research work or, for that matter, the present-day research on such impossible appliances or machines as we feel called upon to name them in the light of our present-day knowledge of the aforementioned branches of science.

When one of these perpetual motion inventors can show us a machine that will operate absolutely *without friction* and in direct defiance of the *laws of gravity*, and, considering these terms in all their multi-

farious and multitudinous phases, in which we are compelled to apply them to all man-made devices and apparatus, then you will probably see such a machine, which will keep in operation forever.

It will probably bring out the point at issue more clearly if we consider a number

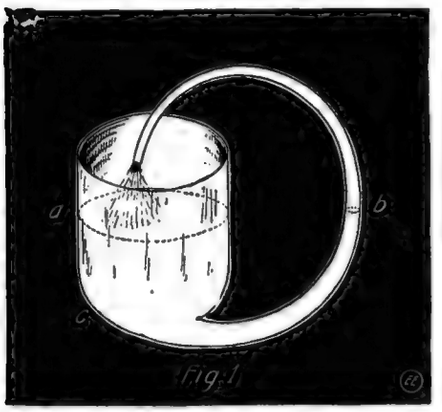


Fig. 1. In This Simple Device the Water in "a" Was Supposed to Overbalance the Smaller Column "b," Causing it to Spout Out Into "a," Ad Infinitum.

of the ingenious ways and methods called into play by the various investigators of this phenomena and consider carefully the deficiencies in same and the reasons therefor.

Referring to Fig. 1, there is observed a hydrostatic device which is supposed to keep on operating forever, and this was invented at an early date. It has been promulgated and adopted over and over again by many sanguine inventors, and it was proposed at one time by the Abbé de la Roque, of France, in 1686. The device comprises a glass vessel of the form shown in the illustration, and, as perceived, the section B is made much smaller than the portion A. When water is placed in the larger chamber A it is, on account of its greater volume and weight, supposed to easily counterbalance the small column of water in the portion B, and hence the liquid would be forced up through the restricted tube section beyond B, and thus discharged back into the bowl A. This is supposed to keep up until the water is evaporated. Needless to say, the inventor, or rather inventors of this apparently remarkable device were con-

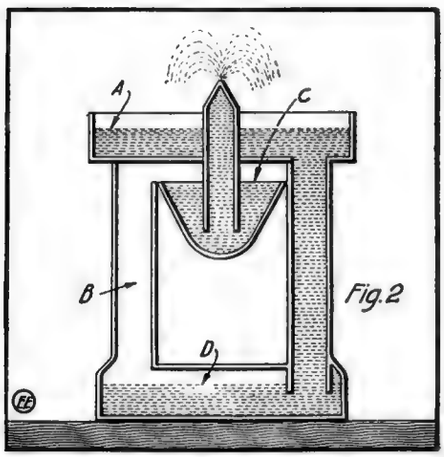


Fig. 2. Hero's Fountain, a Hydro-Static Contrivance Often Considered as a Solution to the Perpetual Motion Problem.

founded when an actual trial demonstrated beyond the shadow of a doubt that the device would not, under any conditions, operate on account of the fact that the liquid maintained an equal level in the chambers A and B in accordance with the well-known laws of hydrostatics. Simply explained, the air pressure per unit surface area remains the same, or, roughly, 15 pounds per square inch. Gravity aids in establishing equal levels in the two chambers or tubes. Reference to any book on physics will serve to clear up this matter thoroughly.

In this direction there was another form of hydrostatic perpetual motion device, known as Hero's Fountain. The sketch at Fig. 2 shows the arrangement of this device, which comprises an upper chamber, A, open to the atmosphere, which chamber is filled with water. The water also passed from this chamber down through a tube or pipe into a lower receptacle D. The pressure was supposed to be transmitted from the water in this way so as to compress the air in chamber B, and thus react on a second water basin C, and thus the liquid was supposed to be forced out of the nozzle at the top of the fountain, as the illustration shows. If such a device would work, needless to say the problem of perpetual motion would have been solved long ago, for this idea dates back hundreds of years. (If the upper basin is larger than the inner one, then the device will operate for a while.)

Electricity, owing to the fact that it has always been but very vaguely understood, even by some of those skilled to a high de-

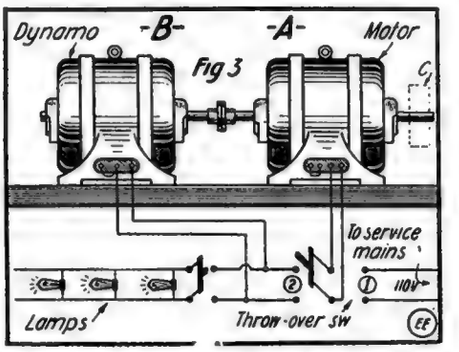


Fig. 3. An Electric Dynamo and Motor, Connected Together, Are Expected to Operate Each Other, and to Even Supply Outside Energy, by Many Amateur Electricians.

gree in the art, has caused a great many students of this branch of science to burn a vast amount of midnight oil in trying to perfect a device employing electricity in some form or other that would keep on the "go" forever.

Among amateur electricians undoubtedly one of the standard forms of this "pipe dream" is that shown at Fig. 3. This necessitates the use of a motor and dynamo connected together in some way or other so that after once starting same from some external source of energy the dynamo will generate the current for driving the motor, and, considering that they are finally interconnected, the motor will in turn drive the dynamo. Thus they will keep on working forever, ad infinitum. To the thorough electrical student this proposed scheme is, of course, absolutely fallacious and ridiculous. In accordance with the well-known law covering the conservation of energy, which states that matter or energy can never be made or destroyed, and also that it is manifestly impossible, at least in our age, to construct a machine that will operate at 100 per cent. efficiency, *without any waste of energy whatsoever,* it will be seen that it is utterly hopeless to think for one moment that such a combination can be made to operate for even a few seconds, let alone months and years, as some inventors fondly think.

As a matter of fact, and to thoroughly bring out the defaults of this arrangement, authentic data is here cited covering the actual performance of such a motor-generator set.

Let us consider that the motor used to drive the dynamo by direct coupling, which is the most efficient method of mechanically connecting the machine, is rated at five horsepower. This considers the five horsepower rating of the motor mechanically at

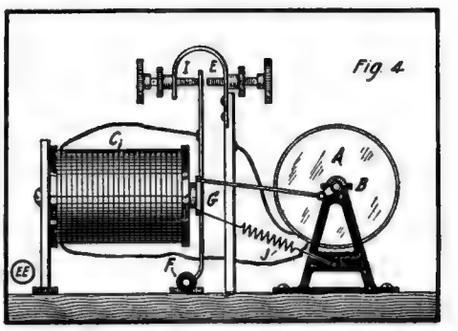


Fig. 4. Electrical Perpetual Motion Machine of an Early Vintage. A Static Generator A Excites the Magnet Coll C, Whose Circuit is Opened and Closed by Contacts E and I.

the driving pulley or shaft. From careful tests made on such machines the relation of the input of the electrical energy to the output of mechanical energy is practically 80 per cent. for this size unit. Hence, if the motor is rated at five mechanical horsepower (in accordance with the rated efficiency), then the electrical input on the motor must be 6¼ horsepower. Considering the aforementioned efficiency loss, the one horsepower is consumed in bearings, windage, copper and iron losses in the motor. There is also some over-all coupling loss in such motor generator sets, and the dynamos are never rated, in properly designed outfits, to correspond with the horsepower output of the motor. If we allow 10 per cent. difference between the mechanical horsepower developed by the motor and the dynamo input, we will then have allowable for this latter value 4.5 mechanical horsepower. Considering, now, that the dynamo has an efficiency of 80 per cent. (for the conversion of mechanical into electrical energy), then it will have an output of 4.5 horsepower times 80 per cent., or 3.6 horsepower. Recapitulating, it is now evident that the gross over-all efficiency of the motor generator set is 3.6 divided by 6.25, or 57.6 per cent.

If the dream of this perpetual motion

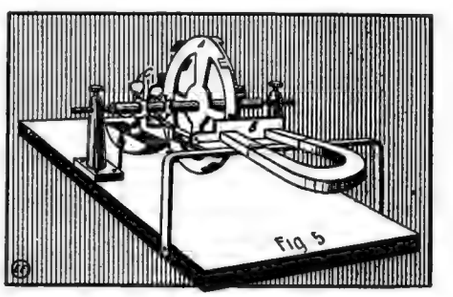


Fig. 5. Another Electrical Wonder Expected to Revolve Forever. A Magnetic Insulator Cuts On and Off the Flux from the Steel Magnet as Perceived.

scheme is to be realized, it will have to be under conditions that will allow of no loss whatsoever, even to the smallest degree; and, of course, as every well-informed electrician knows, this is out of the question. Some of the inventors and re-inventors of this scheme have even claimed that lamps

can be lighted from the dynamo, as well as driving the motor from the same source of energy, and our sketch, Fig. 3, shows this proposed innovation.

There have been thousands of mechanical devices devised to realize the perpetual motion goal, but none of them have proved successful in actual tests. It may be of interest to state that the United States Patent Office experienced no end of trouble with this class of patents and proposed patents some years back, but the annoyance became so pronounced that finally a rule was passed that a "model" of such proposed patents would have to be submitted. Needless to say that this has put a quietus on the perpetual motion dreamer, as there has never yet been submitted to the Patent Office a machine which would keep moving for any appreciable length of time, for the several mechanical and physical reasons well known to any student of the science.

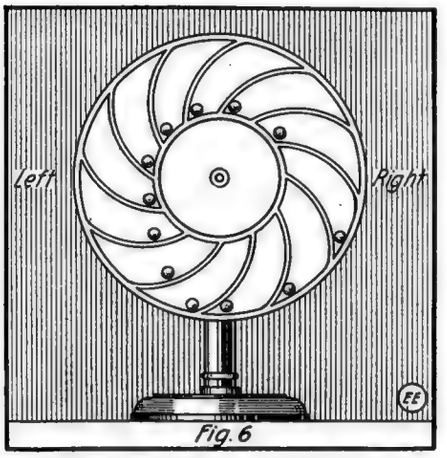


Fig. 6. The Ever-Changing Center of Gravity of the Various Balls in This Multi-Path Wheel Was Expected to Cause It to Rotate Perpetually.

For the benefit of those who have not studied the problem from a mechanical viewpoint it may be worth while to look into the cold facts of "friction." In practically all, or nearly all, of the devices of various types intended to operate forever, there has always been a very appreciable amount of friction to be overcome and which fact was apparently totally ignored in designing the machine. The friction might be very small indeed in the machine, but *it is there invariably*, and cannot be gotten rid of by any method known to us. Some have tried to realize the long-sought-for goal of 100 per cent. efficiency by utilizing devices employing a number of gears —from two to three, and sometimes a dozen or more. As machine designers well know, there is not, nor never has been, a gear train of no matter how few gears that would transmit mechanical energy in a reduced or intensified form (as regards velocity) without some loss of energy in friction and tooth slippage in the gear action. The efficiency of a small gear train may vary from 80 to 86 per cent. or more for medium velocities at the pitch line of the gear. Any machine design or mechanical engineer's handbook will give this data in lucid form, and it has been compiled from many observations and extremely careful tests conducted in laboratories of the leading universities and colleges, which are thoroughly equipped for this work.

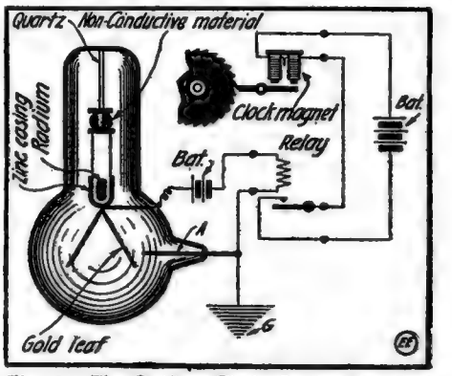


Fig. 7. The Radium Clock, Devised by Prof. Struts, Can Work for 2,500 Years, but Even That Is Not Perpetual!

Any moving objects or parts of a ma-

(*Continued on page* 514.)

Andre Marie Ampère

Born January 22, 1775. Died June 10, 1836

TO this early scientist and investigator, born at Lyons, France, in the year 1775, is due the credit of first discovering the magnetic action taking place between two separate and independent circuits carrying electric currents. He made this discovery shortly after Oersted had found that a wire carrying a current wrapped around an iron core would produce magnetism. With apparatus that was more or less limited he formulated several important laws that are still accepted as being correct in every detail.

The following are the laws discovered and formulated by Ampère:

(a) Two parallel portions of a circuit attract one another if the currents in them are flowing in the same direction, and repel one another if the currents flow in opposite directions.

This law is true whether the parallel wires form parts of two different circuits or parts of the same circuit. The separate turns of a spiral coil, when traversed by a current, attract one another because the current moves in the same direction in adjacent parts of the circuit; such a coil, therefore, contracts when a current is sent through it.

(b) Two portions of circuits crossing one another obliquely attract one another if both the currents run either toward or from the point of crossing, and repel one another if one runs to and the other from that point.

(c) When an element of a circuit exerts a force on another element of a circuit, that force always tends to urge the latter in a direction at right angles to its own direction. Thus, in the case of two parallel circuits the force of attraction or repulsion acts at right angles to the currents themselves.

(d) The force exerted between two parallel portions of circuits is proportional to the product of the strengths of the two currents, to the length of the portions, and inversely proportional to the distance between them.

From the four preceding experimental data Ampère built up an elaborate mathematical theory, assuming that, in the case of these forces acting apparently at a distance across empty space, the action took place in straight lines between two points, the total attraction being calculated as the sum of the separate attractions on all the different parts. The researches of Faraday have, however, led to other views, and we now regard the mutual attractions and repulsions of currents as being due to actions taking place in the medium which fills the space around and between the conductors.

Andre Marie Ampere, After Whom the "Ampere," Unit of Electrical Current Is Named.

Ampère, finding that solenoids act precisely as magnets, conceived that all magnets are simply collections of currents; or that around every individual molecule of a magnet an electric current is ceaselessly circulating. We know that such currents could not flow perpetually if there is resistance when electricity flows from one molecule to another. As we know nothing about the interior of molecules themselves, we cannot assert that Ampère's supposition is impossible. Since a whirlpool of electricity acts like a magnet, there seems indeed reason to think that magnets may be merely made up of rotating portions of electrified matter.

It is worthy of note that Ampère as a boy had very few home advantages, yet by industry and study he managed to acquire a very comprehensive education. When but twenty-six years old the publication of a remarkable series of mathematical papers secured for him the chair of mathematics in the Ecole Polytechnique, of Paris. His knowledge of mathematics was profound and he published a series of memoirs on the mathematical theories of the electro-magnet. This was a task almost beyond human powers at that time, and by successfully accomplishing same he was honored by most of the scientific societies of Europe.

His last work, "Philosophy of the Sciences," showed him to be much less happy in the metaphysical than in his physical and analytical speculations.

In private life Ampère was a man of great simplicity of character and was subject to occasional fits of absent-mindedness, which often made him the subject of much innocent amusement. He was whole-souled and honest, taking no part in petty jealousies, which too frequently disturb the peace of the scientific world even to the present day.

He died universally respected and loved for his great integrity, kindness and scientific abilities. His death, due to a chronic affection of the lungs, came on June 10, 1836. So passed from this world a man who deserves the full admiration of every electrician and experimenter of to-day for his early and excellent basic work in electricity. He paved the way for the rapid progress and development of electro-dynamic machinery.

ELECTRIC FACTORY ON SEA.

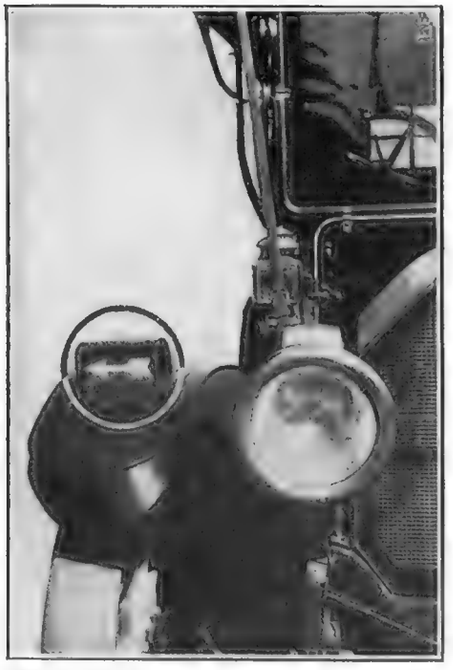
The American ship "Mills" is a floating electrical oil and fertilizer factory. The "Mills" is equipped from stem to stern with electrical machinery. Arc lights and searchlights enable the sailors to catch menhaden fish, similar in appearance to the herring, but not edible. Nets are slung over the side and hauled in by electrical hoists. Electrically driven screw conveyors carry the fish into receiving tanks and automatically feed the steam cookers where the fish are pulped.

The pulp is forced through a rotary press to extract the oil, which is then electrically conveyed into testing tanks, where it is cooled and then carried into storage tanks of 20,000 barrels capacity.

THE LATEST AUTO SIGNAL.

The latest thing in the way of an automobile signal or direction indicator is that recently invented by Ed. E. Peck, of Los Angeles, Cal. This set of signals consists of four small boxes, one of which is placed on the fenders of each of the four wheels of the machine, and which may thus be readily seen from any position.

The operation of this system of signals is extremely simple. When a machine is equipped with this apparatus it is impossible to misunderstand the intention of the driver as to the direction in which he desires turning. If he drives along the street and approaches a corner where he desires to turn to the right he simply turns the little electric switch on the steering wheel to the right. This movement causes the signal over the right front wheel to produce an arrow, as shown in the illustration, indicating that the driver intends turning to the right. At the same time, the two acting simultaneously, the little instrument on the fender over the rear wheel produces the word "Right," so that anyone coming up behind may not be puzzled as to which way the driver of the machine ahead of him is going to take at the next corner. When desiring to turn to the left, the driver simply turns the switch to the "left" position.



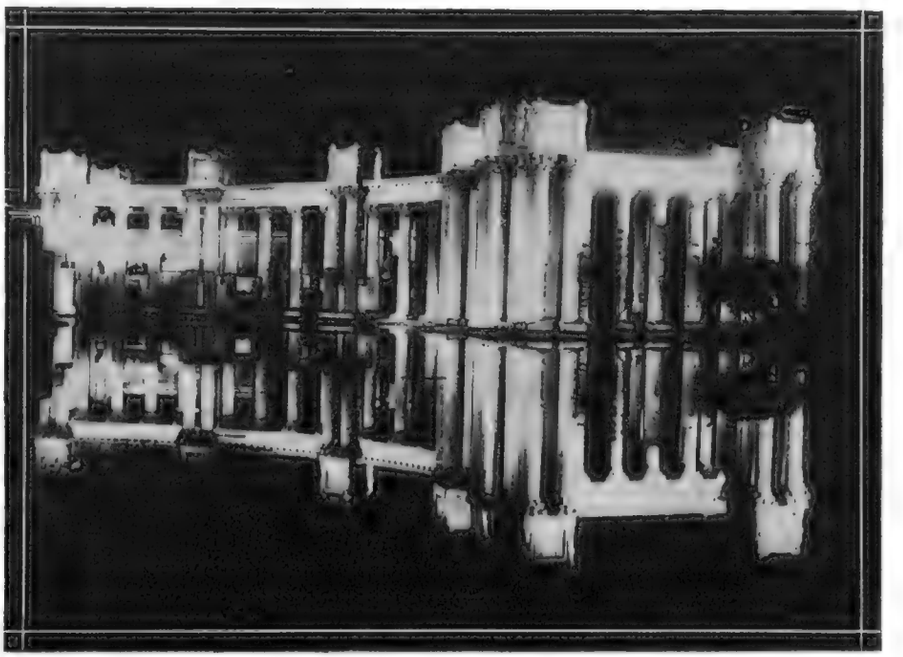
Effective Electric Auto Signal (in Circle) Tells Which Way Driver Intends to Turn.

This signal is so situated that it may readily be seen by the pedestrian and auto driver alike. It is proving quite popular, and promises to be universally adopted before long. The apparatus is waterproof and may be run winter and summer with equally good results.—*Photo by Albert Marple.*

BEAUTIFULLY ILLUMINATED BUILDING AT 'FRISCO EXPOSITION REFLECTS OWN IMAGE.

One of the most brilliantly illuminated buildings at the 'Frisco Exposition is shown in our illustration. This is the Palace of Fine Arts and as observed the reflection in the lagoon at night is so remarkably clear that the picture looks as well upside down as it does right side up. This building is one of those intended to be saved as a memorial of the great exposition, when it shall have closed its doors and will then be no more, except in memory. This picture was taken by the Cardinell-Vincent Co., official photographers of the Pan-American International Exposition.

Thousands of deftly hidden electric bulbs create the striking effect here observed, and this was one of the underlying keynotes in the general arrangement of the whole exposition lighting scheme. The age of glaring electric bulbs or, indeed, any highly brilliant source of light, has passed and illuminating engineers of to-day are as one, in the firm opinion that the best light is a diffused one, providing the proper illumination can be obtained without unduly sacrificing the desired brilliancy and illumination efficiency. The glare from unshielded or direct lighting proves a very sever strain on the eyes and one of the greatest American diseases now prevalent, and one that has threatened the health of thousands of people, is thus innocently caused.

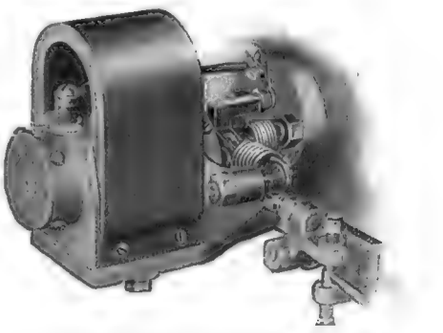


Almost Perfect Reflection of Wonderfully Illuminated 'Frisco Exposition Building.

Millions of electric bulbs of various sizes, types and shapes served to make the exposition one of the greatest in the annals of history, and it may be truthfully said that it appeared as one great blaze of light against the overhanging mantle of night; a sight once seen, never to be forgotten!

OSCILLATING MAGNETO STARTS GASOLINE ENGINE FROM REST.

The majority of magnetos in use to-day on gas engines are not capable of firing the charge in the cylinder of such engines until they have been speeded up considerably. A novel and important improvement in this line has been brought out by a progressive manufacturer in the form of the Wizard oscillator. This permanent magnet type dynamo is fitted to oil or gasoline engines in such a way that at every stroke of the piston in the engine the electro-magnetic armature of the magneto is rocked through part of a revolution in a rapid manner. As we know, it is possible to produce an electric current with a machine so constructed and in which the armature does not rotate at all. If the armature is turned through, say 90 degrees, against a spring pressure suitably applied to the shaft, and then if a trip or cam allows the electro-magnetic member to fly backward a powerful current will be induced in same. Upon this unique principle, which is thoroughly reliable, of course, there has been developed this new form of machine which, most important of all, permits of starting the engine from an absolute standstill. When the engine is turned over slowly, even through one revolution, a magneto of this type will produce just as hot a spark as will ever be produced when the engine is up to full speed. Thus the use of batteries is done away with. The illustration shows one of these oscillating magnetos mounted on a 2½-HP. floating governor kerosene engine. A standard igniting trip with advance and retard mechanism was used.



Unique Oscillating Magneto for Engine Ignition That Rocks Back and Forth Instead of Rotating.

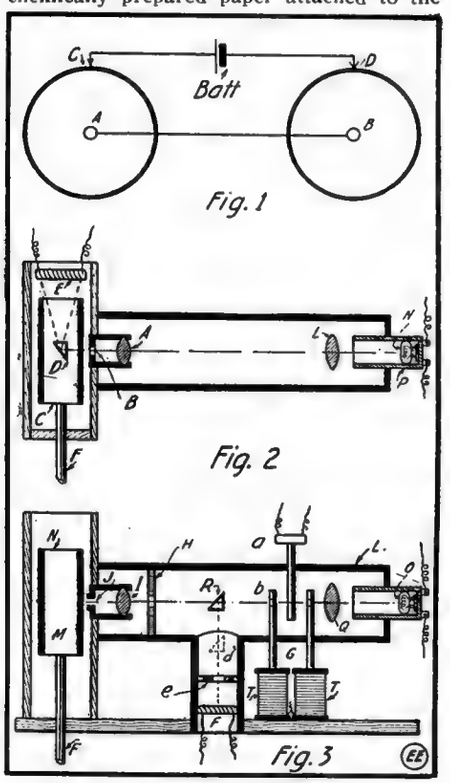
The Transmission of Photographs Telegraphically

By Samuel Cohen

THE transmission of pictures telegraphically has occupied the minds of many engineers and scientists for the past 60 years, until at present several systems have been perfected, to a degree, and placed upon the market as a commercial product. These machines are at present used by several journals, as the requirements for sending photographs from one place to another requires this service to be very fast.

It seems difficult, at first thought, to conceive how a picture can actually be telegraphed. But a picture, just as a written message, can be split up into more or less minute component parts, thereby making a complete photograph when these parts are combined again.

The transmission of photographs over a wire was promulgated back in 1847, when Bakewells began his research work in this line, and it is upon his system that the three most successful modern methods of picture transmission are based. His apparatus consisted of two synchronously revolving cylinders. Upon one was placed a sheet of tinfoil with the sketch drawn in ink; on the receiving drum there was placed a sheet of paper, prepared chemically, so that on passing an electric current through it a stain was made, due to decomposition of the chemical by the electric current. Fig. 1 shows the general schematic diagram of the apparatus, and it works as folfows: When a line in the sketch comes under the stylus C, at cylinder A, the current flowing through the circuit will be broken wherever the cylinder is coated with (shellac) ink; but at such points of the picture where the bare tinfoil lies between the stylus C and the cylinder A the current will readily flow. It therefore flows intermittently through the chemically prepared paper attached to the



Figs. 1, 2 and 3. Telegraphic Picture Transmission Apparatus.

drum B, through the stylus D, and when it flows it makes a (electro-chemical) mark on the paper. Hence, when the stylus has traced over the entire length of the sketch at A, the latter will be finally reproduced at B. Such a system was very readily carried out in the laboratory, but it failed in the commercial field.

Further attempts were made to solve the problem, but it was not until Amstutz and Shelford Bidwell came along and discovered the value of using *selenium*, that mysterious element capable of changing its electrical resistance when exposed to light. The former scheme made use of variations in the strength of electrical current.

The work of these prominent men in this particular field led Professor Korn to develop a new system, and he is to-day the inventor of the most highly perfected machine for transmitting photographs over a wire. His system will be herewith described and is schematically shown in Figs. 2 and 3. The transmitting apparatus consists of a Nernst lamp, N, inserted in a sliding tube, P, provided with the lens L, and in this way a strong beam of light is projected to that part of the apparatus at the left. Here there is placed the lens A, which is mounted in a sliding tube having a small diaphragm at B. This latter comes close up to the glass drum C. Around this drum is wrapped a *positive* photographic film representing the photograph which is to be transmitted. The light passing through certain points of the film is received by a total reflection prism, D, and is sent from thence to the top, where it falls on the surface of the selenium cell E.

As the cylinder is mounted on the rotating shaft F, which operates in the same way as a phonograph cylinder, it revolves and at the same time rises, so that all the points of the image are brought in succession past the beam of light at B. Thus, an opaque point in the film will cut off all the light, and there will be none received on the selenium cell, while a transparent part gives the full light on the cell. The selenium thus receives differing amounts of light, corresponding to each point in the image. As it is connected together with a battery in the line, the distant receiver will receive a current which is variable; these variations following each other in very rapid succession. The receiver then acts according to these changes.

The receiving apparatus employed is outlined in Fig. 3, and it consists of a Nernst lamp, O, and the lens Q, which sends a beam of light toward the left. This beam passes through the apparatus G, which acts upon a galvanometer shutter. G receives the incoming current and serves to cut off more or less of the beam, according to the strength of the current at any instant. The current is received in the upper part (a), which carries the shutter and, moreover, is mounted between the poles of a powerful electromagnet TT. This apparatus is built similarly to the Einthoven galvanometer. The light beam from the Nernst lamp passes through the diaphragm of the galvanometer toward the prism R, on through the screen H, carrying a diaphragm and then passing through the lens I, and small hole J, falling finally upon a photographic film M. This is wrapped about the

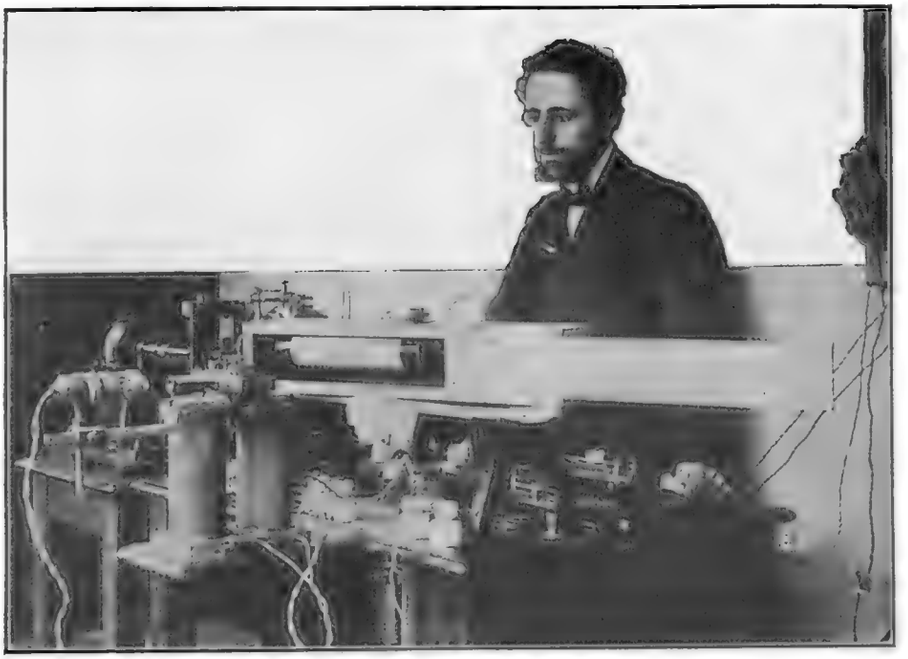
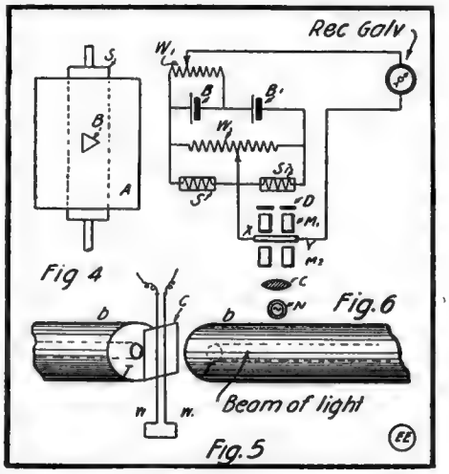


Fig. 7. Prof. Korn and His Apparatus Used in Sending Pictures Over a Wire.



Figs. 4, 5 and 6. Details of Receiving Apparatus.

metal cylinder N, which is rotated at the same speed as that used in the transmitter by means of a synchronous motor. The point of light at J thus acts on the film as it revolves, and as the value of the light corresponds to the white or dark parts of the transmitted picture all the points of the latter are reproduced in succession on the sensitive film; so, finally, we have the whole of the image reproduced. It only remains to remove the film and develop same.

To have the beam of light at the receiver

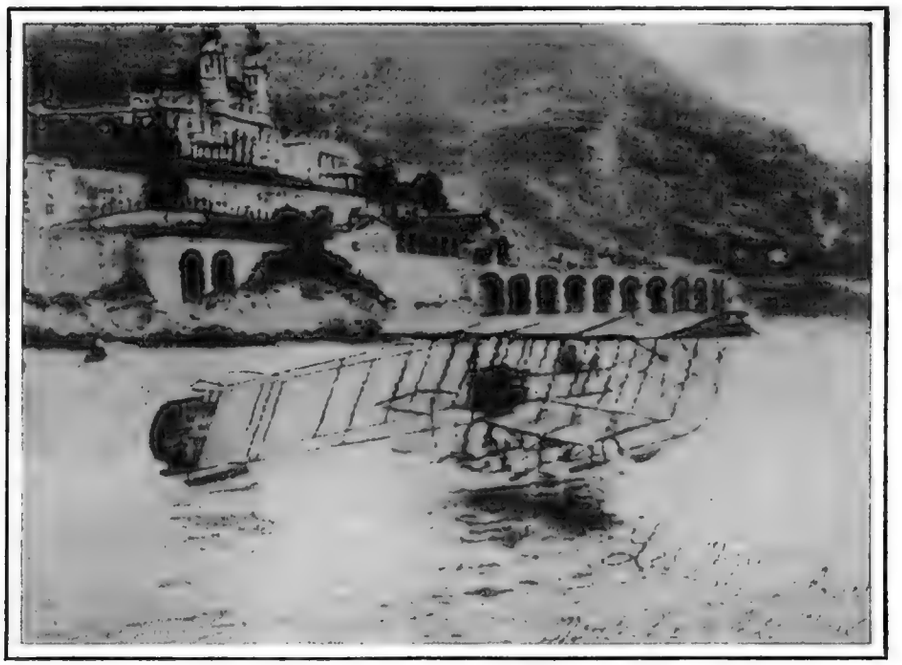


Fig. 9. Actual Reproduced Photograph as Transmitted Over a 400 Mile Telegraph Circuit to a French Newspaper.

correspond exactly to the current values on the line, the swing of the shutter should be proportional to the current, so as to give the proper amount of cut off to the beam of light. But the galvanometer cannot be constructed to have a swing, which is proportional to the current value, and an apparatus to correct this is required. This is depicted in Fig. 4. At A is a screen with a triangular shaped hole, B, which is covered by the shadow of the aluminum shutter C (Fig.

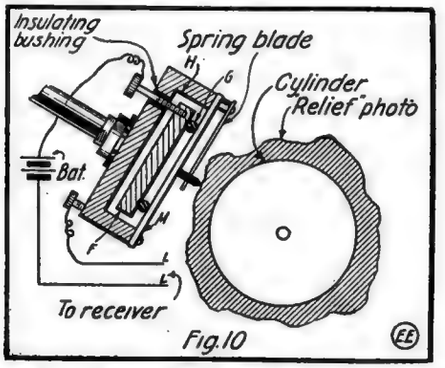


Fig. 10. Microphonic Translating Device for Use With "Relief Negatives."

5); when there is no current passing through wires WW_1. When the shadow moves off the hole the amount of light which is admitted to the lens is varied in a different way from the ordinary, owing to the particular shape of the diaphragm, so that we now have an amount of light which is about proportional to the current in the line. This was one of the hardest problems encountered in the transmission of photographs by this scheme.

While a selenium cell fails to respond quickly enough to the light, due to the inherent inertia of the cell, this was overcome by using another cell in connection with the regular one, and it was also discovered by Dr. Korn. This he called the compensator, and it is schematically depicted in Fig. 6.*

Here the light which has traversed the revolving photographic film falls on the selenium cell S_1. This cell is placed in one arm of a Wheatstone bridge; a second cell, S, being placed in the opposite arm. W is a regulating resistance, and B and B^1 are two batteries of about 100 volts, B being provided with a compensating variable resistance, W_1. The galvanometer is of the "string" form, i. e., two fine wires, X and Y, move laterally in the field of a powerful electromagnet, whose pole pieces, M_1 M_2, are tunneled with a small hole. A small piece of aluminum foil is stuck on to the wire in the center, and it is this shutter which just cuts off the light that would pass from the lamp N through the poles. If current passes through the wires X Y, they are laterally displaced, and the beam of light can then reach the second cell S_1. Now let us see what happens when a bright part in the photograph causes light to be cast on the cell S_1. The equilibrium of the bridge is at once upset, and the current, therefore, passes through X Y; the shutter is displaced and light falls a fraction of a second later on selenium cell S, thereby keeping the current in the receiver constant.

In the receiver we use the total reflection prism R (Fig. 3), which is moved into the path of the light beam, and it sends the beam down the vertical column to the diffusing screen e, and the compensating cell F, as portrayed in Fig. 3. This cell is connected to the main cell, as described above, and the combined current is sent on the line.

Fig. 7 and Fig. 8 illustrate the complete Korn apparatus, while Fig. 9 represents an exact photograph as transmitted over a wire by the above-mentioned apparatus.

One of the most indefatigable workers in the field of photo-telegraphy is M. Edouard Belin, who has been for some years actively engaged in working out a system of his own. His apparatus has been designated the telestereograph, but as his method of transmission has quite recently undergone a radical change it will be better to describe his first successful models by themselves.

The use of a relief photograph in which different tones in the image are represented by different thicknesses of the film, to vary the amount of resistance in an electric circuit containing a suitable receiver, has been referred to in the beginning of the article and the idea is a very old one. But the methods employed by M. Belin, both in the mechanism for varying the resistance and in the means of reception, prove very ingenious, and he obtained some promising results in tests over artificial lines.

The schematic diagram of his sending apparatus is illustrated in Fig. 10. A photograph in relief is obtained by reprinting from an ordinary negative upon what is termed carbon tissue, this being paper coated with gelatine and which is rendered sensitive to light by the addition of sodium bichromate. When sufficiently exposed, the paper is developed in hot water, when the gelatine washes away from the unexposed parts, but remains insoluble where there has been much light exposure; moreover, in the "half-tones" the gelatine washes away only to a certain extent, depending on the amount of exposure, i. e., on the density of the negative. Now let this relief film be wrapped about a cylinder, which quite resembles a phonograph cylinder, as seen in Fig. 10. The transmitter has a special kind of microphone using the metal box H, which contains the metal disc F at the back. Upon this is placed a thin carbon disc having three holes one-tenth of an inch in diameter, and a carbon grain, G, is placed in each hole, so as to make microphonic contact with the outer carbon plate M. The three grains are mounted so as to form an equilateral triangle and thus give an equal pressure distribution. Upon the grains is placed an outer vibrating diaphragm, M, of carbon, as observed. To transmit the movement from the photographic film to the microphone there is used a double point, mounted on a spring blade. One of them bears constantly on the film, and the other against the microphone, so that the latter receives the difference in pressure due to the varying relief on the film. Connection is made between the metal part of the disc F, on one hand, and the carbon plate, on the other, so as to give microphonic action and resulting variations of resistance in the line L L.

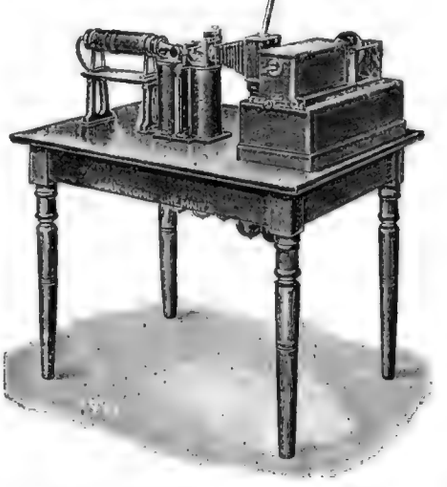


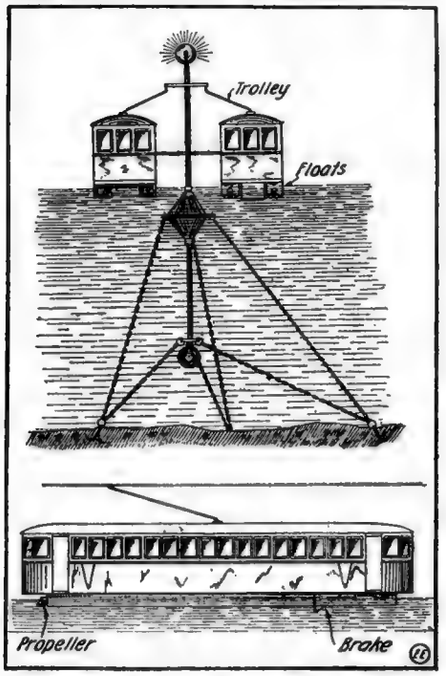
Fig. 8. Complete Telephotographic Apparatus of Dr. Korn.

(*Continued on next page.*)

*From "The Telegraphic Transmission of Photographs," by T. Thorne Baker.

A FLOATING TROLLEYWAY AND PASSENGER CAR.

Here is a real seagoing car and a fresh thrill for the visitors to summer resorts



Recently Patented Floating Railway.

and pleasure parks. The new device is intended mainly for recreation purposes, but it could be easily placed in service as a river ferry for the conveyance of passengers.

The floating trolleyway which transmits the power of locomotion consists of a number of poles, arranged as the purpose for which the device is to be used may prescribe, anchored to the sea, lake or river bed. A car body with an electric motor and passenger-carrying equipment is mounted upon suitable floats, which are pointed at the forward end so that they will offer very little resistance to the water.

A special trolley, which always retains its connection with the overhead wire and arms at the side, which engage a stout wire strung midway between the poles of the trolleyway, help keep the car on the right path, though separate steering means are also provided. The electric power is furnished from any convenient source to the electric motor of the car, which in turn drives the propellers at the rear ends of the floats and sets the car in motion.

At night the car as well as the entire trackway is illuminated, electric lights placed upon the tops of the floating poles being the medium through which the floating trolleyway is lighted. To facilitate the stopping of the floating car when a station is reached, a brake placed between the floats which when dropped enters deep water, offers a strong resistance to the continued motion of the car and brings it to a halt in short order. When the car is in motion this brake is swung upward and out of the water.

This scheme will be practical for ferry purposes only on small inland lakes or rivers, where there are no large vessels and the water always calm.

ELECTRIC SEWING MACHINE MOTOR STAYS WHERE YOU PUT IT.

One of the latest household electrical devices is an improved form of sewing machine motor readily attachable to any style of machine and it also requires no screws or clamps to hold it in place. It is known

The "Dumore" Sewing Machine Motor Remains Where You Set it Without Clamping.

as the "Dumore" motor and is equipped with three special spring feet, as perceived in the illustration. These feet are fitted with rubber cushions to prevent marring the surface of the woodwork, and the cen-

(*Continued on page* 517.)

THE TRANSMISSION OF PHOTOGRAPHS TELEGRAPHICALLY.

(*Continued from page* 483.)

At the receiving end is a similar rotating cylinder, carrying a sheet of photographic paper or a film (Fig. 11), and the currents are received in a galvanometer device which throws a variable spot of light upon the paper. A Blondel oscillograph fitted with a swinging mirror in a strong magnetic field is used in this system. A strong current thus gives more swing and a weak current a lesser swing. The beam of light passes first through a short color screen, C, graduated from dark to light, so that when the beam is at zero it occupies the dark end of the screen. A swing of the beam brings it to the more or less transparent part, and the resulting beam will thus depend in value upon the strength of the current. Fig. 11 shows a diagram of the arrangement of each part of the apparatus. A is the string

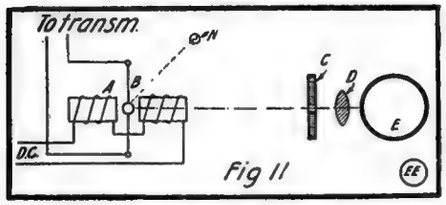


Fig. 11. Details of Receiving Galvanometer.

galvanometer with a mirror, B, attached to a fine wire which is connected to the transmitter, as perceived. A ray of light from a Nernst lamp, N, is focused upon the mirror, which reflects it toward the receiving cylinder E, in the meantime passing through the screen C, and condensing lens D. The revolving cylinder E is kept at the same speed as the transmitting cylinder, this being done by means of a synchronous electric motor on each end.

The latest achievement in the transmission of photographs is that employing wireless telegraphy. The great advantage of wireless over wire telegraphy is quite well known to-day for its long distance and the communication with ships at sea, and the same application can be applied to photo-telegraphy when a proper system is developed. For instance, pictures of criminals could be readily telegraphed to ships fitted with proper receiving apparatus, and sketches or plans could be transmitted between different corps of an army or between ships.

Various systems were developed, but the most practical one is that which T. Baker, of England, has perfected, and this is schematically illustrated in Fig. 12. The upper one shows the transmitter, while the lower one is the receiver.

At D is a drum, the same as used in the wire photo-telegraphic apparatus, a stylus tracing over a sketch drawn with insulating ink on a sheet of leadfoil; D and the stylus are shunted with a condenser, C, to prevent sparking. The current from the battery A is interrupted by the lines of the picture, the magnetism in M being thus intermittent. The relay at M breaks the contact of the battery B in circuit with the primary P of an induction coil; S being the secondary, and thus electrical oscillations are set up in the aerial AN and ground GR. A negative print is placed on the drum D, so that sparking between the balls B_1 takes place only when a line in the picture comes in contact with the stylus. The capacity K and inductance J in the oscillatory circuit can be adjusted as required, and for long distances the aerial and earth would be connected inductively.

Turning now to the receiving apparatus, the aerial and ground are connected to the primary of a loose coupler, LC, the current being transformed into the secondary, S, and passed through a sensitive coherer, C, with a condenser, K, in series. A rather insensitive relay is inserted in the coherer and battery circuit, the battery consisting of the two dry cells. The local circuit of this relay actuated a second relay through another battery, and the local circuit of this second relay included the receiving circuit of the photo-telegraphic apparatus, as becomes apparent.

The use of a shunt circuit running through the receiver was necessary to render the marks clear and short.

A local shunt circuit was also used from the first relay to actuate the de-coherer, which consisted of a very lightly built electromagnetic striker which tapped the coherer.

Quite wonderful results were obtained

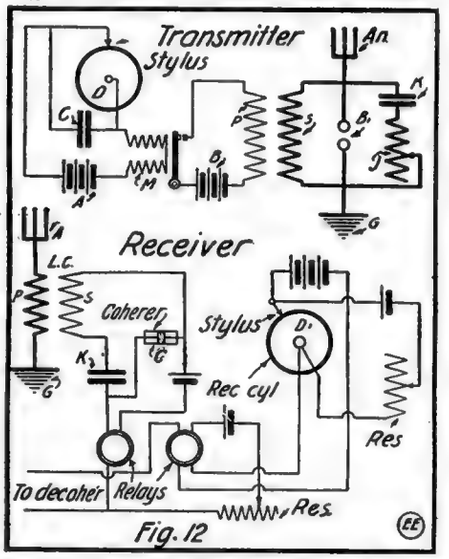


Fig. 12. Circuits of Apparatus Used in Radio Transmission of Pictures.

with this apparatus, and photographs were readily transmitted for short distances, although the received pictures were not very clear.

The time is near at hand when we will be able to send our pictures to our friends in distant cities and ships at sea as easily and cheaply as in sending word messages.

RADIO DEPARTMENT

Wireless on the Firing Line

ONE of the most important elements in the present European conflict is wireless telegraphy, which is very extensively employed for directing squads of soldiers, communicating between trenches and exposing the enemies' position by means of aerial reconoitering.

Various types of instruments are being used and we herewith present some views of the transmitting sets which are in use for this purpose. Fig. 1 illustrates a typical synchronized outfit, comprising an open core, oil-cooled, transformer A, connected to an alternating current supply, through a key, as usual. Its secondary is linked to a specially designed condenser B; this is carefully built, as it is sometimes necessary to overload it. The spark gap C is of the rotary synchronized type, and is mounted on the end of the generator shaft. The helix D is of the standard type, consisting of a spiral of brass strip held in fiber supports, as perceived. This outfit has a capacity of 150 watts, with a radiation of one ampere in the aerial. The ground connection is simply made to the base of the engine. The set has a spark frequency of 800 per second; complete, it weighs about 30 pounds. The apparatus is designed and constructed particularly for operation on an aeroplane, where the air draft created by the motion of the machine is utilized for cooling the various parts, especially the spark gap.

Another unique wireless plant designed especially for use in aeroplanes is depicted in Fig. 2. This is somewhat different from the one previously described, as it employs a stationary gap A, instead of a rotary one. The gap cooling funnel B is used for concentrating the forced air produced by the motion of the aeroplane. The high tension condenser tubes C are placed behind the frame, as perceived. These are of a similar type to those used in the previously described set. The helix D is of standard type; note the method of changing the wave length on same by means of a switch. It employs a novel scheme, on the rotating arm E, which does not scrape the metallic band when the arm is revolved. A hot wire ammeter F is employed for indicating the current in the antenna circuit.

A very interesting illustration is shown in Fig. 3. This is an actual photograph of an aeroplane of the biplane type, fitted out with a wireless transmitting outfit of the same design as that just described. The stationary air cooled spark gap is shown at A, while the key K is located on the operating table. The aerial is sometimes made to comprise the guys of the flying machine, providing they are insulated from the engine proper, as the latter is employed for the ground. If these guys are grounded, then a long wire is lowered from the aeroplane, which is wound up and let out from an automatic winding drum, easily controlled by the aerial radio operator.

French Aeroplane Radio Equipment. Note Aerial Weight at Left, Which, Attached to a Flexible Wire, Enables Antenna to Be Unreeled to Any Length Quickly.

TWO NEW WIRELESS DETECTORS.

An enterprising wireless concern of New York City has recently developed an improved mineral wireless detector which undoubtedly will find great favor with both amateur and commercial radio operators. This detector is of very sturdy construction and rests on a marble base (see Fig. 1). Two hard rubber uprights support a glass cylinder, which incloses the working parts of the detector proper and thus prevents dust settling on them, besides keeping out dampness, etc. The hard rubber knob A, at the left, has a rotary movement and carries the "cat-whisker" wire, which rests against the mineral mounted in a cup and carried on the stem connected to the knobs B and C, at the right. The knob B permits of rotating the shaft on which the mineral cup is fastened in an eccentric manner, so that any portion of the mineral becomes accessible to the contact wire or "cat-whisker." By means of the smaller knob C, and by turning it, the cup may be approached to or receded from the "cat-whisker" wire; a strong spring placed under the mineral cup tends to push it forward normally. A distinct novelty in this detector is the tube D, which connects with an inner passageway opening into the glass chamber. This tube is for the purpose of introducing any gases or compressed air, etc., into the detector chamber, so their effect on the operating characteristics may be noted and experimented with. Ordinarily, if no gas is to be used in the detector, the tube may be closed with a cap. It has been found that, for instance, illuminating gas increases the sensitiveness to a remarkable degree. A novel way in treating the galena renders this detector practically immune from all light shocks.

Another detector of the mineral type and of commercial pattern is shown in Fig. 2. This detector resembles a cartridge fuse and may be snapped in and out of place in

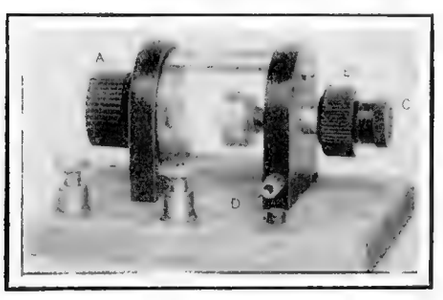


Fig. 1. Improved Dust-Proof Detector Fitted With Gas Inlet for Experimental Work.

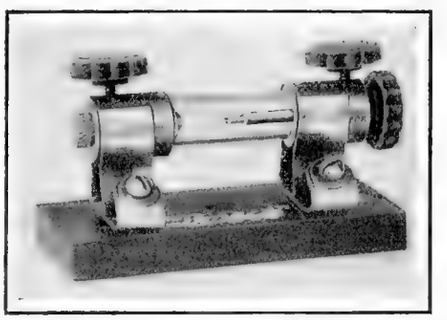
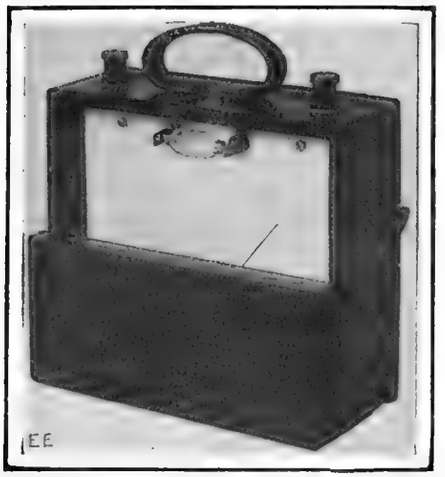


Fig. 2. The Lenzite Detector Utilizes a Synthetic Mineral and Is Also Dust-Proof.

(*Continued on page* 516.)

A DIRECT READING WAVE METER FOR RADIO MEASUREMENTS.

In the accompanying illustration is depicted the first commercial type produced of a direct reading wave meter as developed and perfected by Dr. Georg Seibt, of Berlin-Schoenberg, Germany. This in-

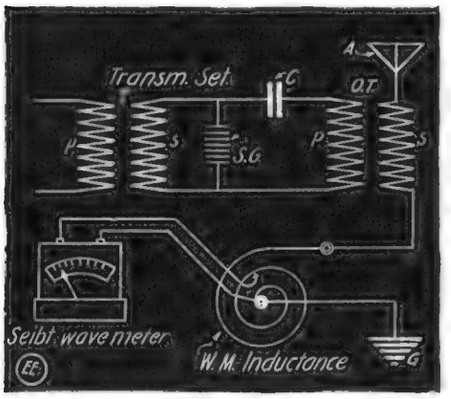


A Direct Reading Wave Meter That Resembles Ordinary Voltmeter.

strument is connected in the ground wire of the wireless transmitting system and as near to the earth connection proper as possible. It is inserted in the circuit by shunting the meter itself across an adjustable inductance composed of a few turns of copper ribbon, which inductance is hooked up in series with the ground wire, as diagram shows.

This particular instrument has two calibrated scales, the first scale reading from 300 to 1,500 meters wave length, the second scale from 1,500 to 3,000 meters wave length. It is quite delicate in construction, but, however, is more rugged than would seem at first possible. This was demonstrated in a test of same which was conducted on an aeroplane wireless set, where very severe vibrations were encountered.

This meter is very peculiar in action as compared with most other direct reading electrical instruments, in that its needle does not have any definite zero point, and it may come to rest at any point along the scale, depending upon the wave measured



How the New Wave Meter Is Connected to a Radio Transmitting System.

when last used. When the meter is connected in circuit the needle of same very quickly takes up the proper position, indicating directly the wave length in meters of the circuit to which it is attached. One feature about this instrument is that the scale divisions are equal and thus easily read.

It has been tested by Dr. Austin, of the United States Bureau of Standards, and found to have an accuracy of approximately 1 per cent. Readings are preferably taken with this instrument when it is placed in a horizontal position.

No iron enters into the construction of the wave meter, and motion is produced in its mechanism by means of two hemispherical coils, oppositely disposed on either side of a very light aluminum member, which is mounted very delicately on a pivot and an indicating needle is attached to this movable member.

A switch mounted on the side of the wave meter permits of changing the internal connections, so that either scale may be used. Directly above the scales may be observed an indicating glow lamp, which is used for the following purposes: Theoretically the indications of the wave meter are independent of the current flowing, but in actual practise it is necessary to keep the current between certain maximum and minimum limits for best results. When very small currents are passed through the instrument there can be no certainty that the friction of the pivots exerts no effect on the reading, or that a slight unbalancing of the armature will not render negligible the effect and also that the slow motion of the pointer or needle under the action of small currents makes the reading uncertain. To readily ascertain that the current flowing through the meter has the correct value the small indicating (tungsten) lamp above the scale is noted. This lamp is so chosen that the slightest dark red glow indicates the minimum allowable current, while a bright white light in the bulb denotes the maximum permissible current which should be passed through the wave meter. It does not matter whether any particular degree of brightness is obtained, but in order to have the small glow lamp last the longest possible time it is desirable to work nearer the lower current limit. For those interested in the details of the actual construction and peculiar operating features of this very ingenious device it would be well to refer to Vol. 1, Part 3, of the Proceedings of the Institute of Radio Engineers.

MARCONI RADIO SCHOOL IS OPENED.

Telling of the wonders accomplished by wireless telegraphy of late, Instructors Warren C. Graham and T. George Deiler recently opened the new school for the training of commercial radio operators, recently recommended to be placed in New Orleans, in the Young Men's Christian Association building in St. Charles street, by the Marconi Wireless Telegraph Co. of America.

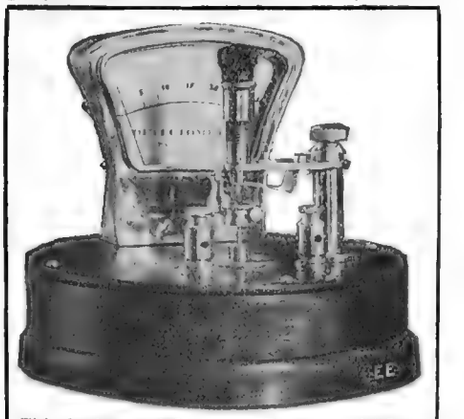
The opening of the new institution was well attended and a large number of pupils were enrolled. The successful operation of the school is now assured, and it will be permanently established in New Orleans.

The novel institution, which is the only one of its kind in the South, has been thoroughly fitted out with Marconi apparatus valued at $4,800, similar in type to the sets used on ocean liners, and will not only instruct students in the operation but also in the maintenance of commercial wireless apparatus.

A DEVICE THAT MEASURES PRESSURE ON DETECTOR CRYSTALS.

A novel and apparently quite useful wireless device, known as a Detectometer, has been perfected and patented by Arthur G. Carlson, of North Easton, Mass. Mr. Carlson is a rather youthful inventor and he has apparently developed in this instrument a more or less useful device for the measurement of the pressure exerted on wireless detector minerals. The photograph and sectional drawing herewith will help to bring out the general appearance and working arrangement of this apparatus.

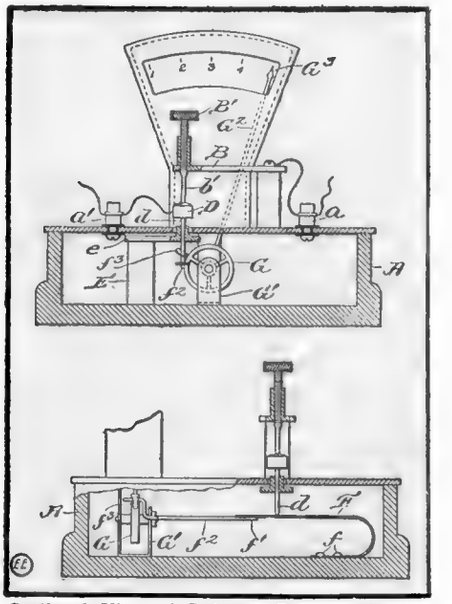
Referring to the sectional sketch, there is observed a standard form of mineral detector having a lower cup D, containing the mineral proper. On the mineral there presses downward an electrode b^1, carried



This Instrument Measures Pressure of "Cat-Whisker" Contact in Mineral Detectors.

by the metal bridge B. As increased pressure is exerted on the mineral by threading downward the electrode B^1, the lower end of the cup shaft, d, presses down on spring F. This spring is connected through f^3, with a small balance wheel G, supported in the bracket G^1. As will be evident, increased pressure downward at D thus causes the pivoted wheel G to rotate, and in consequence the attached needle, G^2, will indicate on the calibrated scale at the upper part of the instrument.

The inventor of this device claims that it will be of superior value, as proven by actual tests, when, for instance, a radio operator may wish to readjust the detector with a certain mineral and under certain conditions. Presumably such is the case, and the patentee mentions also that it often happens that 15 to 20 minutes or more are wasted in trying to adjust otherwise the mineral in the detector to its maximum sensitivity; whereas, with this calibrated electrode pres-



Sectional View of Detector Pressure Gauge.

sure indicator, it is the work of but a minute or so to instantly readjust the detector to its most favorable condition.

AN ULTRA-SENSITIVE WIRELESS RECEIVER.

The accompanying sectional drawing Fig. 1 illustrates the mechanism of a telephone receiver which is designed especially for increased sensitiveness. This receiver is

Fig. 2. Appearance of New Amplifying Wireless 'Phones.

of the watch case form and is adapted particularly to service in wireless telegraphy. Other forms of the receiver embodying the same general principle are useful in cases of partial deafness, for noisy places and in long-distance telephony.

The diaphragm 12 (see diagram) is not acted upon directly by a varying magnetic force as in other receivers, but it is made of mica and receives its impulses from a thin iron armature 9, to which it is connected by the link 14. This armature passes through an opening in a spool 8 (upon which is wound the single energizing coil of magnet wire) and is poised at the middle upon a pair of pivots, or preferably a fine wire loop, which is attached to the center of the spool. A spring 16 is arranged to press upon one end of the armature 9 in such a way as to produce a slight tension upon the link 14 and diaphragm 12, and at the same time hold the armature in proper position.

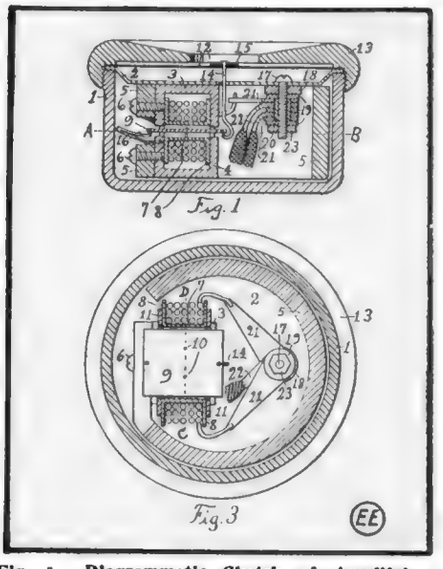


Fig. 1. Diagrammatic Sketch of Amplifying Receivers.

The spool is nearly surrounded by two U-shaped pole-pieces 3 and 4. A permanent steel magnet 5 surrounds these parts, and its poles, being made narrow, overlap and are secured to the pole-pieces by screws 6, 6. This holds the pole-pieces and spool together, and the cup-shaped member 2, which is secured to the pole-piece 2, forms a support for all these parts. This cup-shaped member, together with the diaphragm 12, is clamped between the shell 1 and ear-piece 13.

It will be seen that the flux from the permanent steel magnet 5 has a double path between the pole-pieces 3 and 4 across the armature 9. When there is no current in the spool of magnet wire the armature remains balanced. When a current traverses this coil the armature becomes polarized; and readily it can be seen that the magnetic action of all four ends of the pole-pieces will co-operate to produce a deflection of the armature 9 upon its fulcrum 7 in a direction depending upon the polarity of the energizing current. An alternating or varying current will produce oscillations of the armature, and this motion is transmitted to the diaphragm.

The following are features of advantage in the instrument. It has a long permanent magnet, being more than a complete circle, since the ends overlap. The magnetic circuit has comparatively little reluctance, having a double path between the pole-pieces. The air spaces are thin and the flux from the permanent magnet does not have to pass lengthwise through the armature.

These features of the magnetic circuit favor a strong flux and permanency of magnetization.

In the electro-magnet the thin armature is the main part which is affected by the energizing current; therefore the loss of power by hysteresis and eddy currents is reduced to a minimum. The winding is concentrated in a single spool and its effect upon the armature is utilized at both ends and on both sides at each end. In this way the force due to the polarization is increased to a maximum.

The diaphragm, being of thin mica, is very light and sensitive to the impulses from the armature. The diaphragm, armature, link and spring, together, weigh only a fraction of that occasioned by using a common iron diaphragm.

For wireless service these receivers are provided with a new form of head-band, which is very simple and somewhat automatic in adjustment. Fig. 2 shows the appearance of a head-set consisting of receivers, head-band and cord.

In this set two leather-covered, spring steel wires carry sleeves at their extremities. These sleeves hold heavy German Silver wires, which are split at one end and formed into arms which partly encircle the receivers. Pivots in the extremities of these arms engage with sockets in the receiver shells.

These wires can turn in the sleeves and the receivers can turn on the pivots. The wires can also slide in the sleeves to adjust the length; but when the set is upon the operator's head the binding effect of the wire in the sleeve prevents slipping. With these adjustments made, the set is simply placed upon the head in proper position, and it will stay there. There are no screws or fastenings to tighten.

NEW CABINET STYLE RADIO RECEPTOR.

The sponsors of the well-known Crystaloi detector have recently developed and commercialized a high-grade wireless receiving cabinet set which our illustration herewith shows. This set includes switch style tuning inductances and the outfit may be tuned to quite long wave lengths up to 3,800 meters. Special switching arrangements have been developed in this outfit which conduce to very rapid tuning, and the central dial switch has its contact points so arranged that with very little movement same is easily made to throw in either the short or long wave inductance sections which are, of course, inductively related and controllable by means of the two end dial switches.

The Crystaloi detector is seen mounted on the set, as well as the sliding plate, variable condenser, and this is perceived mounted at the center of the cabinet shelf. This condenser was described in the September, 1915, issue of the *Electrical Experimenter* and varies its inherent capacity by sliding more or less plates along two brass bars, half the length of which are specially insulated. By varying the distances between the plates by means of spacing washers it can thus, if necessary, be made up to cover a pretty fine range of adjustability, although, apparently, on first sight it would not give the fine range of adjustability procurable with the standard rotary variable style condenser.

This set tunes very sharply and also very quickly, all things considered, and the detector is indeed very rugged and permanent in its adjustment, a feature not to be

Newly-Developed Radio-Receiving Set Equipped With Crystaloi Detector.

found in ordinary radio receiving sets. This outfit comes complete and is furnished in a polished mahogany cabinet, while the shelf on which the switches and various parts of the apparatus are mounted is made of Bakelite. Even a dust brush is supplied with this set, as perceived, so that the apparatus may be kept scrupulously clean! This applies particularly to the space between the closely arranged switch points, where dust is likely to collect and the high frequency currents flowing through these parts may thereby be short-circuited, which will naturally lower the electrical efficiency of any apparatus of this type.

THE WIRELESS 'PHONE WILL GET YOU.

Many a man in the spring of the weather and of youth has stood on his doorstep and longed to be able to shout his thoughts to all the world. Many have felt this, but few have ever thought they could do it. Wireless telephony has made such a scheme within the range of the possibilities. If your wife is cross, or your enemy is hot on your trail, or the partner wants to tell you that note falls due to-morrow, don't think you can go to San Francisco or China and get away from her or them. Gadzooks! You can't—the wireless 'phone will get you.

Regenerating Audion Circuits for Wireless Receiving

By Frank J. Collins

THE arrangement of circuits and apparatus described in this article were invented by Edwin H. Armstrong, of Columbia University, and are to be used experimentally only.

While the coils described herein may be constructed by experimenters, they are not permitted to sell them to others for the purposes described, as the invention is patented.*

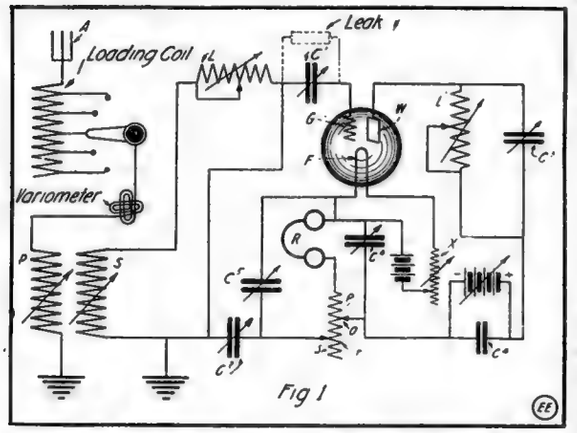


Diagram 1, for Regenerative Audion Detector Circuits.

The purpose of this discourse is to describe in plain and simple language the operation of this scheme, so that amateurs may construct and use same. While this arrangement may seem quite complicated in comparison with the ordinary audion circuits in common use, still, with a little practice all difficulties may be overcome.

These circuits are adapted to the reception of both damped and undamped waves, and are particularly suited to the latter.

When properly adjusted, this arrangement has an amplifying figure of from 10 to 500 times or more, depending on the amplitude (strength) of the incoming signal. In contrast to the ordinary audion amplifying circuits, only one audion is required, thus eliminating two or more audion bulbs, extra rheostats, batteries, etc.

As most of the high-power transatlantic and transpacific stations use wave lengths of from 5,000 to 10,000 meters, dimensions are given to cover these wave lengths only.

With an aerial 500 feet long, one wire elevated at least 40 feet above the ground, no difficulty will be experienced in reading stations 2,000 to 4,000 miles distant, day or night. Aerials 100 feet and up in length may be employed with good results, but for reliable communication a length of 500 feet or more should be used whenever possible on account of the long wave lengths employed.

The dimensions and description of the apparatus to cover the range of wave lengths mentioned are as follows:

Loose coupler primary tube 4 inches in diameter, 5 inches in length, wound full with No. 32 S. S. C. wire, bringing both ends of the winding to binding posts. No sliders or switches are necessary, as the full winding is always required.

The secondary tube is 3½ inches in diameter and 6 inches in length, wound with No. 32 S. S. C. wire; no taps are required in this case either, as the full winding is always in use.

As a great many of the high-powered stations use the "arc system" requiring very sharp tuning, a variometer is necessary. While a variable condenser may be shunted across the loose coupler or loading coil, or both, for sharp tuning, a variometer is preferable. A loading coil will also be required in order to tune to the long wave lengths.

The Grid and Wing Coils, L and L¹, Fig. 1, are identical in every respect. They consist of cardboard tubes, 30 inches long and 4½ inches in diameter, wound full with No. 32 S. S. C. wire. About fifteen equally spaced taps should be taken from each coil and brought out to switch points.

The switch on the Grid Coil should be connected to the last tap of same in order that the unused turns may be short-circuited or the entire coil cut out of circuit.

The switch on the Wing Coil should be connected likewise, viz., to last tap of the Wing Coil. Care should be taken in connecting these coils up to the other apparatus to see that the switch on the Grid Coil is connected to one side of the secondary of the loose coupler and that the switch on the wing coil is connected to the positive side of the high voltage (40-50 vts.) battery.

By short-circuiting the unused turns of the coils in this fashion, it prevents the operator's hands from interfering with the tuning to a large extent. These coils are very sensitive and should be placed at least two feet from each other, or at right angles, in order to reduce the mutual inductance between them.

The wing condenser, C 3, Fig. 1, is used for the purpose of tuning in longer waves than the inductance of the coil itself affords. It is also used for the purpose of "cutting in" between the taps of the wing coil, and has a maximum capacity of .0004 m. f.

The tuning condenser, C, is for the purpose of tuning the grid coil and the secondary of the loose-coupler to the incoming signal; it is very essential. It has a maximum capacity of .0004 m. f. In most cases a maximum strength of signals will be obtained with large values of inductance and small values of capacity, for a given wave length.

Since the internal resistance of the high voltage telephone battery constitutes a path of comparatively high impedance to the high frequency oscillations (incoming signals) it is advisable to use condenser C 4 (Fig. 1), connected directly across the battery as shown, in order to reduce this impedance. This condenser is not really necessary. It has a capacity of about 2.5 m. f. and may be adjustable in steps.

Care should be taken in constructing this condenser, for should it "break down" it would result in the complete loss of the high voltage battery by short-circuiting the same. Paraffin paper and tinfoil may be used in its construction.

Condenser C¹, Fig. 1, is very important and is placed between the grid coil and the grid of the audion, and it is used for the purpose of holding the charge which accumulates on the grid due to the incoming signals. Its capacity is very small, seldom exceeding .0002 m. f. This condenser is preferably shunted by a graphite resistance (leak).

This *leak* may be constructed by clamping a piece of cardboard 1½ inches long and ½ inch wide, between two binding posts, the whole arrangement to be connected across the condenser C¹. Then while "listening in" draw a few lines with a lead pencil from one binding post to the other on the cardboard. (These lines of graphite constitute a high resistance.)

This process should be kept up until the incoming signals reach a maximum of strength, as the effect of this resistance is to materially increase the strength and clearness of the signals. By decreasing this resistance (in ohms) static disturbances are decreased to a large extent, but at the expense of the incoming signal strength.

This resistance should be connected up after all the apparatus is hooked up and working, as the right amount can only be ascertained while signals are being received.

Condenser C 5, Fig. 1, is connected directly across the telephones and is very essential. It maintains the stability of the audion when receiving long waves and prevents the audion from generating high frequency oscillations. By keeping sufficient capacity across the telephones at all times this generating feature may be eliminated. The capacity of this condenser is .001 m. f. (maximum). The generating feature of the audion may be recognized by the signals losing distinctness, and a hissing or rumbling noise is noticeable in the telephones.

By grounding the grid circuit, as indicated in Fig. 1, the generating function may be eliminated to a certain extent.

The amount of voltage required in the telephone circuit will depend to a large extent on the degree of vacuum present in the audion bulb. Since all audion bulbs vary in their characteristics, the adjustment of apparatus obtained with a given audion bulb, when receiving signals from a certain station, will change when another bulb is substituted. The change of adjustment being principally in the grid condenser C¹ and inductance coil L¹, Fig. 1. It has been found best to have the ratio of transformation 2 to 1 in the transformer T, when its primary inductance value is equal to that of the telephones. (Or a telephone induction coil may be used.)

While the ordinary audion bulb is admirably suited for the reception of undamped waves, the double wing and grid audion bulb will give better results, as it is more stable and shows less tendency to "paralyze."

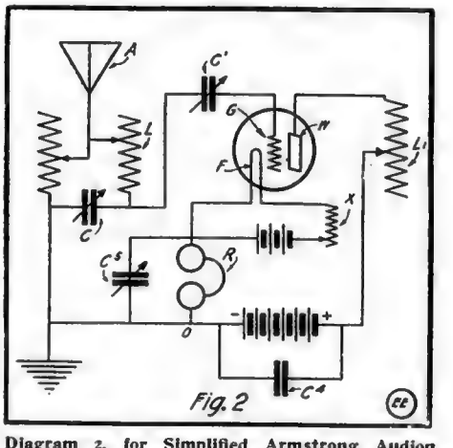


Diagram 2, for Simplified Armstrong Audion Circuits.

Another feature of this arrangement is the fact that the filament of the audion bulb may be adjusted to a comparatively low temperature, thereby prolonging the life of the bulb.

(*Continued on page* 517.)

* Patented Oct. 6, 1914, by Edwin H. Armstrong.

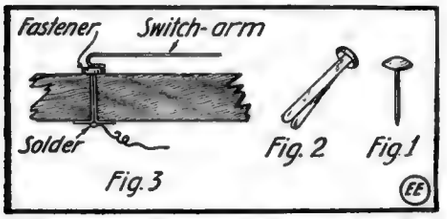
REGARDING SWITCH POINTS AND TIKKERS.

In making switch contact points a common practise is to use upholstery tacks as in Fig. 1, but frequently the shank is not long enough to pass through the mounting. In that case ordinary paper fasteners, Fig. 2, are used as sketched at Fig. 3. They may be obtained in many sizes and lengths, and are almost as cheap as the upholstery tacks.

They are excellent to use where it is necessary for the points to be set closely, in which case the manufactured switch contacts cannot be used because of the nut on the back.

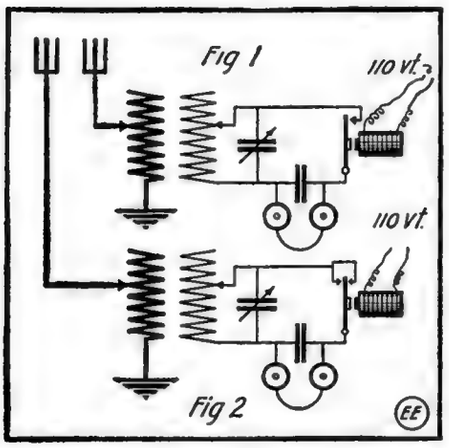
Many amateurs within range of the "Poulsen Arc" sets are making use of various forms of "tikkers."

Some of them use telegraph relays con-



Using Paper Fasteners as Switch Points.

nected on 110 volts alternating current, as in Fig. 1. This does not give good results for the reason that the interruptions are too slow. Much better results are obtained by following the circuit shown in Fig. 2. This simply makes use of the "back stop" as a contact, and when connected as shown the arrangement gives twice the number of interruptions as before, consequently better results. It must be remembered that neither arrangement approaches the "wheel" or "tube" tikker in efficiency, and the relay should only be used when the



Two Methods of Utilizing Telegraph Relays as "Tikkers."

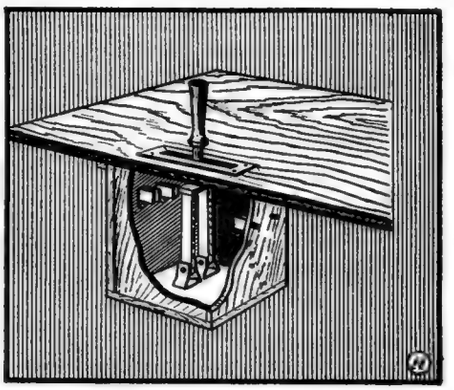
other forms are impossible of attainment or impracticable. Contributed by
FREDERICK J. SCHLINK.

QUICK-THROW AERIAL SWITCH.

An aerial switch is an awkward thing on a radio table. It is always hard to place effectively. Here is a new way.

The ordinary double throw switch is used. Take it apart and mount in an enclosed frame, as shown in drawing. This frame is fastened to the under side of the table and the switch handle, by means of an extension, projects through a crevice in the table top. The slot is covered with a brass slide way, to give a neat appearance.

This method of mounting the "aerial switch" ensures increased speed and comfort in operation. It also has the much



Nifty Form of Aerial Switch.

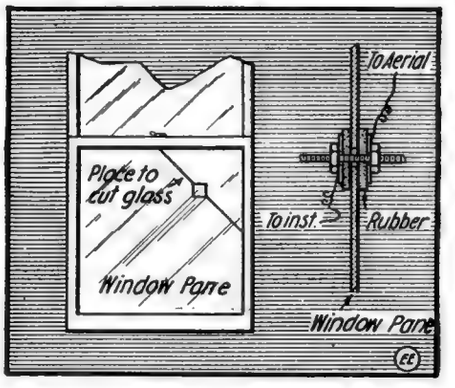
desired nifty "commercial" appearance.
Contributed by EARL H. SWANSON.

A SIMPLE EAR CUSHION FOR 'PHONES.

Many amateurs and even professional wireless operators often become very uncomfortable after listening for a long time on account of having the head receivers pressed against their ears. Many of them have purchased pneumatic ear cushions to overcome this, but a cheaper way is always patronized. Any person can construct these by taking a piece of rubber sponge about 2½ inches in diameter and about a half inch thick, allowing an inch on either side to fasten to the head-band clamp that holds the receiver; then punch or cut a hole about a half inch in diameter to allow the sound to reach the ear. It is now complete, and will also serve as an "ear muff" for the cold weather as well as a cushion. A piece of sponge may be bought for a dime in a drug store or novelty shop. Contributed by IRWIN DERSCH.

FILING GLASS WINDOWS FOR LEAD-INS.

In building my wireless station I had some trouble with the lead-in. I did not want to disfigure the window frame, so I decided to cut off a large corner of the window pane itself. Then I filed a notch in each piece large enough to receive my lead-in wire without touching the sides of the hole. I used a threaded copper rod for the lead-in. A rubber washer with a nut was placed on each side to keep out the air. The best way to file glass, without danger of breaking it if you are careful, is to hold it *completely under water*



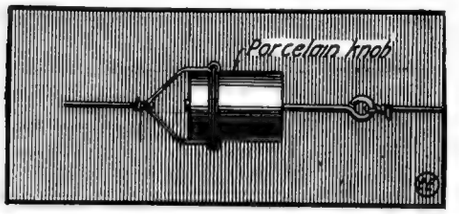
Way to Cut Window Glass for Lead-In.

while filing the notches. I found this lead-in suitable for a 1 k.w. set. Contributed by WALTER FRANSEEN.

PORCELAIN KNOBS AS STRAIN INSULATORS.

A simple method of using porcelain knobs as strain insulators is shown in the sketch herewith. A nail or piece of steel wire is arranged as perceived, so that it cannot be pulled through the center hole and a loop is formed of one end of the knob into which a guy wire or Antenna wire is secured. The second support from the insulator is made of a piece of wire clamped around the groove of same, as shown.

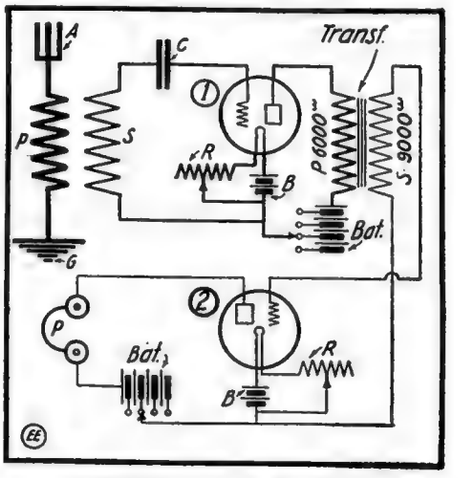
A number of these knobs may thus be placed in series, of course, in the usual way, to increase the resistance of the arrangement and to provide in this way, increased insulation value. Contributed by
F. W. SULLIVAN.



Strain Insulator Easily Made from Porcelain Knob.

AN AUDION TRANSFORMER.

An Audion transformer has recently been put on the market by a well-known electrical concern, which is herewith shown. It consists of a primary coil wound over a soft iron wire core about 9 inches long and having 6,000 ohms resistance. Over this winding a secondary is made with fine wire (about 36 B. & S.) having a resistance of 9,000 ohms. This is then connected



Audion Transformer Hook-Up.

as outlined in diagram. The primary coil is connected to the first detector, which can be either of the crystal rectifying or Audion type, while the secondary is connected to an Audion detector in connection with a loud-speaking telephone for amplifying the incoming radio signals.

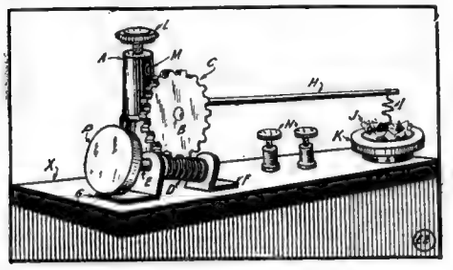
BRASS POLISH.

This formula consists of the following: 16 lb. *Crude Oleic Acid*, 5 lb. *Kieselguhr*, 4 lb. *Tasteless Mineral Oil*, 1½ oz. *Lemon Oil*. Mix the powders into a paste and gradually thin with the mixed fluids, being careful to prevent formation of lumps. Apply with a rag or waste, and when practically dry rub with another rag or waste.

A NOVEL DETECTOR STAND.

The illustration shows a type of galena detector which is capable of extremely minute and delicate adjustments.

The base X should be about 4x3x¾ inches. Locate a point on the base about 1 inch from one end and 1¼ inches from the side and fasten a large double binding post A to the base at that point. Next



Worm and Gear Adjustment for Detector.

obtain a piece of brass rod B, about 2 inches long, which should fit snugly the lower hole in A. On one end of B fasten a brass gear C. Drill a hole through the other end of B to take H, a brass rod about 3 inches long and a trifle smaller than B. Near the projecting end of H solder a small spring I, made of No. 20 brass wire, to make the contact with the galena crystal held in the cup K.

Cut a strip of 1/16-inch brass ¼ inch wide into two pieces ½ and ⅝ inch long, respectively. Drill two small holes near one end of each of these pieces to fasten them to the base. Near the other end of the longer piece drill a ⅛-inch hole, and near the end of the shorter one solder a small tack with just a little of the point left. Bend these brass pieces so as to hold the worm D in mesh with C, and also to give D a slight upward angle sufficient for the typewriter knob P to clear the base.

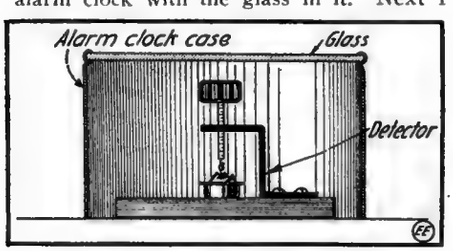
Make a slight indentation in the exact center of one end of D to turn on the tack soldered to F. This may be done with a center punch. Solder a ⅛-inch rod E to D. This rod passes through the hole in G, holding D firmly between F and G.

To assemble the whole suspend the worm D between G and F and secure them to the base with small round-headed screws. Care should be taken that D turns easily and does not bind. Pass the rod B through the lower hole in A. After placing the gear C in mesh with D tighten the set screw that clamps it to B so that C will turn, but will not move out of mesh with D. Wedge or solder the rod H in the hole in B. Secure the typewriter knob P to E and mount the binding posts N—N on the base and the detector is complete except for the crystal J.

Contributed by K. ROBERTS.

DUSTPROOF COVER FOR DETECTOR.

I procured the metal case of a discarded alarm clock with the glass in it. Next I



Alarm Clock Case Forms Efficient Detector Cover.

unscrewed the legs and the post which holds the bell, then I assembled it as shown in the accompanying sketch. The whole arrangement presents a very neat appearance, and the detector is always in view.

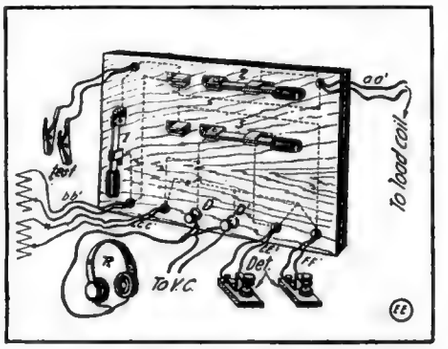
Contributed by J. WALLACE PECKHAM.

A WIRELESS RECEIVING "TEST" BOARD.

Many radio experimenters, when conducting tests, employ an extra receiving set, and during the operation usually cause the regular set to become deranged, thereby necessitating the rearrangement and putting together of the set every evening. However, by mounting the "test" board described below at some spot where it will remain unmolested and using flexible leads, the main apparatus will be left intact, while it will be possible to use both receiving sets at the same time on different wave lengths, if desired.

Two good points about this arrangement are that, instead of using binding posts, *long leads* in the form of stranded wire are brought out from the board through small holes. The leads to the aerial and ground have clips on their ends, which connect to the aerial switch blades.

The diagram is explained as follows: Switch No. 1 turns on test set; switch 2 cuts in or out a loading coil connected to leads A A¹, while switch 3 gives the choice of two detectors connected to E E¹ and F F¹. For connecting receiver tips, spring binding posts should be used at D D¹. A



Handy Test Board for Radio Receiving Station.

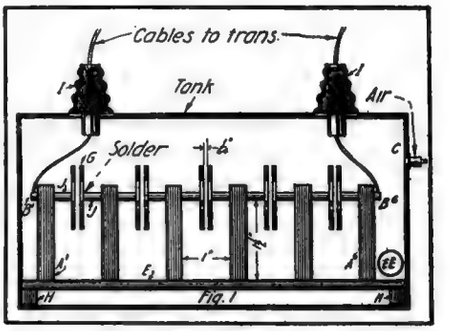
secondary loading coil may be connected at X.

Contributed by W. R. COTTRELL.

A COMPRESSED AIR SPARK GAP.

The average experimenter is not very familiar with the qualities possessed by the compressed air spark gap, due to the reason that it is seldom used. I present herewith the method of constructing a gap which radiates a sharp, pure wave, very similar to the well-known quenched type. If constructed right it will give as much satisfaction as a quenched gap and is, besides, much cheaper to build.

Obtain a heavy metal can about 6x3 inches, and two spark plug porcelains; in my case these were 2x¼ inch. Through the top of the can (Fig. 1.) bore two holes which have a diameter large enough to admit the insulators I. Cut out of hard rubber the base E, which measures 6x1 inch. Bore five holes, each hole being 1 inch from the other and large enough to admit an 8/32 machine screw. Cut out of ¼-inch brass rod (five) or six standards A, each 1½ inches high. Drill a 3/32-inch hole for ¼ inch up into the standard. At the top of the standard also drill a 3/32-inch hole at right angles to the length of it and which extends through same. This drilling having been done on the other four, they are screwed into place on the base so as to have the top holes in a line. Ten zinc discs G, 1 inch in diameter by 1/16 inch thick are turned out and are welded or soldered to the threaded rods J, as per illustration, so as to face each other. The discs G should be 1/64 inch apart. The rods J should be, when adjusted, soldered to the standards B. The gap thus being completed, should now be mounted on two blocks H, which measure



This Spark Gap Utilizes Compressed Air, with a Gain in Efficiency.

1x¼ inch high by ¼ inch thick. Take care not to have any metal part of the gap touch the can. The posts H may be glued onto the can so as to hold them in place. A No. 8 copper wire should be run through both insulators I, long enough to run to the transformer and reach the standards B_1 and B_6. This being done, the space left in the insulator should be cemented up. In some convenient place on the can bore a hole large enough to admit the air valve C, which may be of the bicycle tire variety. Solder the valve to the can and cement a 1-foot length of the right size rubber hose to the valve.

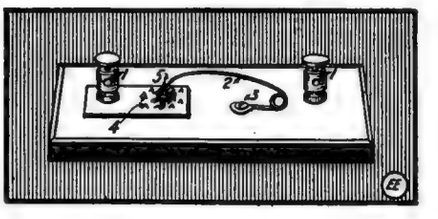
The most important thing is to reinforce the can by recementing and resoldering all metal joints (solder the cover on very firmly). Be sure to cement up joints where holes have been drilled. The whole gap is next immersed in hot sealing wax so as to completely cover can, the thicker the cement and wax film is the better, taking care not to get the air hose leading from the valve C clogged. For cooling purposes immerse gap in oil. By referring to the drawing all omitted details may be found.

Operation: Attach tire pump to valve hose and pump in at least 40 pounds of air. The pressure may be obtained by a tire gauge. Do not have more than 50 pounds pressure or the experiment will likely prove decidedly disastrous.

Contributed by H. SMELTZER.

A "SAFETY-PIN" DETECTOR.

Here is a sketch of how to make an efficient and substantial detector from a safety-pin. The drawing speaks for itself. (*Safety first!! Ed.*) 1 and 1 are the binding posts; 2 is the safety pin cut and bent as shown; 3 is the screw to fasten it to the base, and from there runs a wire to one binding post. At 4 is a piece of brass



A "Safety-Pin" Detector.

perforated to make a rough base, so that the mineral 5 will not slip.

Contributed by LOUIS H. BUEHL.

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Manager, H. Gernsback

IT is with the greatest pleasure that we report the exceedingly large response from prospective members to the RADIO LEAGUE OF AMERICA.

When the December issue first appeared we had an idea that the movement surely would be endorsed by a great many wireless amateurs, but we did not expect the extraordinary support which has been experienced up to this writing. Every mail brings dozens of applications, and there seems to be no let-up whatsoever; quite the contrary, the replies seem to increase daily. Present indications are that before the month is over the LEAGUE will have considerably over 5,000 members.

This response of patriotic wireless amateurs is certainly more than gratifying, but we are quite certain that we are only at the beginning and that within the next two months, when the movement becomes better known, that the response from the amateurs will become still more insistent. We have heard from every corner of the Union and from almost every city of any importance. A very encouraging result is that the parents of the younger boys are very much interested in the movement, there having been received hundreds of letters from them congratulating the LEAGUE upon the movement.

If by any chance you should not have seen the December issue carrying the announcement of the RADIO LEAGUE OF AMERICA, we urge you by all means to send for that number, as it explains the movement in detail.

While we thought we had stated everything in plain language, in the announcement we have been asked quite a few questions which we try to answer here.

Many prospective members desire to know if it is necessary for a member to be of age in order to be eligible. The answer to this question is that *anyone* born in the United States is eligible as a member, providing he is at least 14 years old.

Although we stated the fact, and although reproduction of the membership certificate in our December issue shows it clearly, there have been quite a number of inquiries if there are any dues to be paid in order to become a member. To this we again would state emphatically that *there are absolutely No Dues whatsoever to be paid* and that anyone born in the United States or anyone who is an American citizen can become a member of the LEAGUE.

Quite a few prospective members wanted to know if more than one application would have to be filled out in case the station was owned jointly by two or more amateurs.

Answering this question, it has been decided upon that where two or more persons own a wireless station, each will be entitled to become a member, providing the back of the application states this fact. Thus on the back of the application the following line should be written and signed:

The above instruments are owned jointly by: (Insert here the names of parties owning the station.)

There seems to be some misapprehension in the minds of most persons as to pledging their stations to the Government in case of war. A number of prospective members have an idea that in case they pledge their station to the Government they thereby automatically pledge themselves and their services to the Government. Nothing could be more wrong.

In this case the owner would be pledging his station to the Government in the same manner as he would pledge his automobile to the Government while he himself would not necessarily have to serve in the army unless he expressly desired to do so.

We call particular attention to the annexed blank published at the suggestion of Capt. W. H. G. Bullard, U. S. N. After carefully reading its contents it will be apparent that even though you do pledge your services to the national Government, *you are at liberty to withdraw this pledge at any time you desire to do so.* While this would, of course, not be a very patriotic act, the Government realizes that not everybody who pledges himself for service now can possibly be expected to do so five or 10 years hence. Conditions may change, as well as health, etc., which may make a future withdrawal not only logical, but it may, indeed, be to the benefit of the country.

As to pledging the station to the national Government, the underlying idea of this is that in case of necessity the Government could count upon using your station should it become necessary for the welfare of the country to do so. It, of course, would not matter whether you were there to operate your station or not. In this case your station would be used in the same manner as the Government would use a private telephone or telegraph line which it would operate in war time, the same as if it belonged to the Government.

The manager will at all times be glad to answer any questions pertaining to the movement which are not entirely clear to prospective members.

The following letter has been received from Capt. W. H. G. Bullard, U. S. N. We urge every LEAGUE member, as well as every prospective member, to read it carefully:

NAVY DEPARTMENT,
U. S. NAVAL RADIO SERVICE,
Office of the Superintendent.
RADIO, Va., November 23, 1915.

Mr. H. Gernsback, Editor, THE ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York:

DEAR SIR: In reply to your letter of November 22, 1915, which I have read with much interest and for which I wish to thank you in connection with your offer to co-operate with this Service in obtaining volunteers for the Naval Radio Service in time of war, I am enclosing herewith a copy of the original circular letter drawn up by this office, changed in some respects so as to suit the circumstances, and which I shall be pleased if you will publish in your magazine.

Very truly yours,
W. H. G. BULLARD, Captain, U. S. Navy,
Superintendent of Radio Service.

NAVY DEPARTMENT,
U. S. NAVAL RADIO SERVICE,
Office of the Superintendent.
RADIO, Va.

SIR: The necessity of having a list of experienced radio operators who would be available for service on naval vessels and all naval shore radio stations in time of public peril is very evident, and it is desired to obtain the names of such men in times of peace, and to revise the list from time to time as required, so that the Navy would not suffer from lack of operators or delay in training them, when the necessity arises.

The form attached should be filled out and mailed to the Superintendent of Radio Service, if you will signify your intention to offer your services to the Navy as a radio operator as outlined in the first paragraph of the form.

This will in no way interfere with your occupation in time of peace, and can be withdrawn at any time, should you so desire (see last part of paragraph 11 of form).

Referring to paragraph 7 of the form, it will be the intention as far as practicable, in accordance with your qualifications and the needs of the service, to assign you to the duty for which you express a preference.

The Navy will offer an opportunity to operators to continue in their chosen profession and at the same time give them an opportunity of serving their country in its hour of need. This latter, it is believed, should be a determining factor in assisting you to decide to offer your services to the Navy at that time.

The office of the Superintendent will be very glad to furnish upon your request, any further information in regard to this important subject.

The enrollment of your name among those who signify their intention to serve the country when required for the national defense will be of great assistance in the efforts the Navy is making to carry out its policy, "In time of peace prepare for war," and in this policy, you, as well as every American citizen, should be deeply interested. In the particularly important branch, the Naval Radio Service, you will not only show your interest, but will aid in making it effective by a declaration of your intentions to offer your services.

Very respectfully,
W. H. G. BULLARD, U. S. N.

[NOTE.—If you do not wish to tear this page out of the magazine you can make a copy of the form on a sheet of white paper. The questions should be filled in carefully and the blank sent to Radio, Va.]

(Place).....

(Date).....

Superintendent U. S. Naval Radio Service, U. S. Naval Radio Station, Radio, Va.:

SIR: 1. In the event of the United States needing my services as radio operator, owing to exigences due to public peril, it is my intention to offer my services to the Navy Department as a radio operator during the time for which the exigency exists, according to such regulations or laws as may be in force at the time covering enlistment in the Navy.

2. I am a citizen of the United States
3. My age is at the present date
4. My present address is
5. My home address is
6. My present occupation is
7. My preference for duty is (state ship or shore station)
8. I hold a license as radio operator issued by the Department of Commerce with number, date and class as given
9. My experience in radio telegraphy is as follows: (State briefly experience in operating radio sets, names of stations, ship or shore, with types of apparatus. Also give any experience with land telegraph or cable companies, and any other qualifications in reference to ability as operator).
10. I can send in Continental Morse Code, ... words; American Morse Code, ... words; I can receive in Continental Morse Code, ... words; American Morse Code, ... words.
11. In case of any change in the information given under 4 and 5, or if for any reason it becomes necessary for me to change my views concerning my present intentions, as expressed in paragraph 1, I will so inform the Superintendent of Naval Radio Service.

Very truly yours,

Name .....

Address.....

This letter was received from Dr. Lee de Forest. Its importance will be appre-

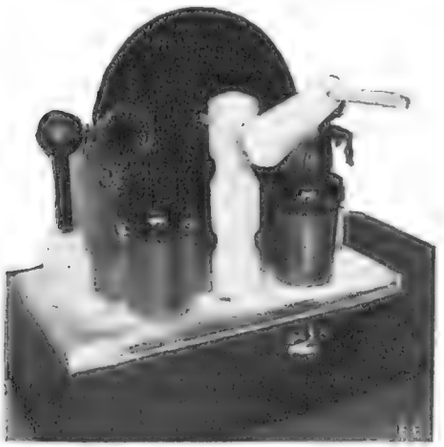
(*Continued on page* 501.)

THE CONSTRUCTOR

How to Make a Simple Static Machine

By E. F. Hallock

THE experimenter, especially the fellow who dabbles in things electrical, oftentimes finds himself in a bad way for want of a static electric machine of one sort or another. Just why he should go without is a mystery; for, while the machines on the market are, for the most part, 'way beyond the reach of the average experimenter, so far as price is concerned, anyone who is handy with tools can make



A Simple Static Machine Constructed from Phonograph Record and Other Everyday Materials Found About the House.

a real serviceable frictional electrical machine in a few hours' time. And, far from being complicated, the construction of the machine is the acme of simplicity. The materials to be used are right at hand in most workshops, all save the disc itself, which is nothing more nor less than a simple phonograph record, made of hard rubber composition or vulcanite.

Just why the hard rubber disc is used, instead of the more commonly employed glass will at once be apparent to the experimenter who has endeavored to , or perhaps has, cut out a nice, perfectly round disc of glass, and ground the edge to a fine finish, only to break the fragile material when it came to drilling the hole for the passage of the mandrel or spindle. The record is all prepared; perfectly shaped and ready "drilled," and, after all, is just about as good a dielectric as the glass and in every way suited to the work it is to perform in connection with the electric machine.

The photograph gives a very good idea of the appearance of the finished machine, and comparison with the six-inch pliers shown in the foreground will give a good idea as to the relative dimensions of the various parts of the machine. In connection with its serviceability, it might be well to point out that this little machine will give a spark well over 2½ inches long, when used in connection with the small Leyden jars shown, and that the character of the spark can be varied from a sharp, snappy crackling spark to a wide brush discharge. For igniting gases, demonstrating electrical principles, illuminating Geissler tubes and a variety of other experimental uses, this simple machine answers all requirements.

The base is a piece of wood about three-quarters of an inch thick, roughly 15 inches long and nine inches wide. Hard wood is preferable to soft, and close-grained wood to the open-grained variety. For appearance sake it should be neatly planed, the edges beveled somewhat, and the whole smoothed off with sandpaper. Of course it can be painted; but, in view of the fact that most paints are made from a base of white lead, which is an electrical conductor, it is best to varnish the base, preferably with shellac, so as to preserve it from moisture.

In the machine shown the standards through which the mandrel passes are turned on a lathe, but even this is not necessary, for perfectly plain uprights will do just as well and will not be far behind the more ornate ones in appearance. These standards are about nine inches in height and the shaft is journaled in babbit bearings cast in them.

The phonograph disc is prepared by sandpapering the record side down till the surface is perfectly level, using finer sandpaper after the greater part of the lines has been removed. The surface is then given a polish with rouge cloth, so that both sides are perfectly smooth. The disc used is 10 inches in diameter.

The electrical effect is created by means of a rubber, or a pad of silk mounted on a fork, which, in the illustration, is hidden from view by the handle of the machine. This silk is stretched tightly over a packing of silk trimmings, so that the inside surfaces of both branches of the fork are covered; the fork, which is made of brass, straddles the disc, so that the pads are in contact at all times with both surfaces of the record. The fork is supported from a brass ball, in turn mounted on a hard rubber rod. The latter is held firmly in place by means of a wooden cup turned for the purpose and firmly attached to the base of the instrument, as perceived.

A similar arrangement of insulating rod and ball supports a brass collecting ring at the opposite side of the disc. This ring, which is rounded and free from sharp edges from which the current escapes more readily, is provided with a number of sharp points on the side facing the disc, which *very nearly* touch the surface of the plate.

The plate is mounted on a shaft of Bessemer (machine) steel, a few nuts and washers serving to hold the plate firmly to the shaft, which is threaded from one end to the middle to provide the bearing for the nuts. Care should be taken in mounting the plate perfectly true. The handle can be formed simply by bending the rod to form a crank, though in the machine shown a built-up handle was used.

Jelly glasses form the better part of each of the Leyden jars. The glasses are coated with tinfoil half-way up on both inside and outside surfaces. Hard rubber tops should be used, through which protrude brass rods provided with short lengths of brass chain at their lower ends to form the contact with the inner coatings of the jars. Similarly, chain is used as a ready means of connecting the jars to the respective sides of the machine.

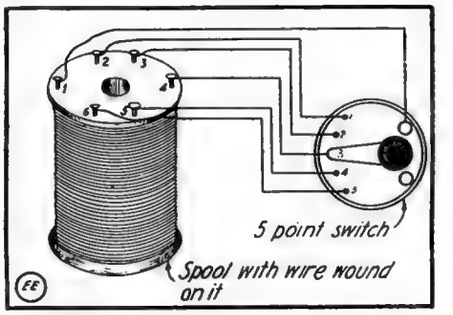
As was said before, the whole machine can be made within a few hours' time, but for all its simplicity it is effective. Its operation is improved somewhat, and at the same time the life of the silk pads is increased if the pad is rubbed with a small quantity of amalgam made of zinc and mercury.

LEATHER DRESSING.

An effective rain-proof leather dressing can be made as follows: To 2 parts of *Common Glue* liquefied by heating, add 3 parts *Castile Soap;* dissolve by heating together with 120 parts *Water,* stirring until a good mixture is obtained. Add 4 parts *Spirit Varnish,* and then mix 2 parts *Wheat Starch* with *Water* and throw in. For black leather sufficient *lampblack* can be added without killing the gloss of the dressing.

HOW TO MAKE A STEP-DOWN TRANSFORMER.

First obtain ¼ lb. of cotton covered No. 36 gauge copper wire, which comes on a tin spool which you will need later. Unwind the wire and then rewind it, tapping off six places at equal distances to control the current. It is best to number the taps as you wind the spool, the first, No. 1; second, No. 2, etc. Now place the tin spool and coil in a pint fruit jar and fill it one-half full of oil; cylinder oil is excellent



Easily Made Step-Down Transformer.

and can be procured at a garage at a small price. Placing the coil in oil prevents it from becoming hot. The next step is to connect the spool to a five-point switch, as in the diagram, and the coil is ready for use. It should be connected to the apparatus it is to operate in series with the 110-volt lighting current.

Contributed by
ALEXANDER V. BOLLERER.

Electrical Helps for Amateur Photographers

By P. Mertz

HERE are, doubtless, quite a few readers of *The Electrical Experimenter* who dabble in photography. These frequently find it of great advantage to be able to apply their experience with electricity to the taking and making of pictures. It is for them that this article has been written, and it is hoped that it may be of some benefit.

1. An Electrical Shutter Release.

There frequently come up cases when

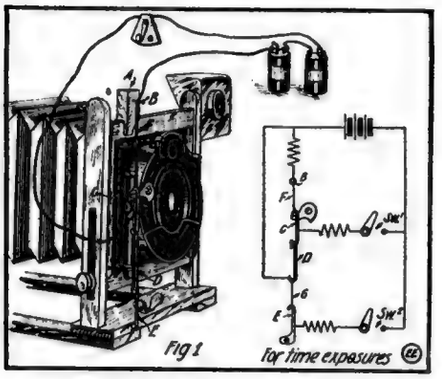


Fig. 1. Electric Fuse Arrangement for Releasing and Closing Camera Shutter.

the photographer cannot stand near the camera to release the shutter, such as when he wants himself to be included in the picture, or, in bird photography, or in a number of other circumstances.

There are several devices for this purpose, each with its advantages and its disadvantages. The writer has devised an apparatus, which has given perfect satisfaction, and which he believes has some advantages over the others.

Its principle of operation depends upon the melting of a fine (No. 40 B. & S.) iron or copper wire, which releases a spring or rubber band, which, in turn, trips the shutter.

The details of construction, as devised for adaption to a 3A Kodak, fitted with automatic shutter, are shown in Fig. 1. A wooden bar A has a slot cut in at the bottom, and fits closely on the lens-board between the front upright and the bellows. It holds a nail or screw B. A piece of wire C is bent into shape and fitted on the finger release. A strong rubber band D is hooked on to the lower end of C. For instantaneous exposures the lower end of the rubber band is hooked on to another piece of wire E, which itself is hooked to some part of the frame. One end of the fine wire F (of iron, if possible, as it will require less battery; and size No. 40) is twisted around C, the other end around the nail B, its length being so adjusted that it just prevents C from tripping the shutter. At the time of exposure a battery current is turned on between B and C; which will melt the wire and allow the rubber band to pull down the finger release.

If a time exposure is desired, the additional fine wire G (shown in the supplementary illustration) should be attached between the rubber band and the frame, and the shutter set at BULB (*not time*). Wire F is fused first, and, after the required time has elapsed, wire G is fused.

For the connections, annunciator wire or flexible cord of the same size are very good—a too fine wire should not be used, as it will reduce the current appreciably. Care should also be taken to use the smallest possible amount of connecting wire, as too much of this, also, will tend to weaken the current.

The switch used should preferably be of the lever type rather than the push-button type, as, unless a heavy current is used, the fine wire does not fuse instantaneously. If it is not inconvenient to keep up the pressure for a second or so, however, a push-button may be used. For time exposure, two switches are required, as shown in the illustration.

As to the amount of battery required, I have found one dry cell to be sufficient, although two would be better. A flashlight battery of three cells may be used if the wire to be melted is very fine, *short* and of iron, and the connections rather short and heavy.

The device has been described for use with only one make of shutter, as there are too many different types used. The use of a little ingenuity will, however, enable the "electrician-photographer" to devise one for his own particular make of shutter and camera.

2. An Electrical Flashlight Apparatus.

It is frequently convenient to set off a flashlight from a distance. For such purposes an electrical arrangement is extremely useful. However, the usual method is to use a spark coil and have the spark ignite the flashlight powder. A much simpler device is to use (as in the preceeding article) a piece of fine iron or copper wire, which will become red hot when the current is turned on and ignite the magnesium mixture.

The powder is put into the cover from a tin can, which itself is on a board (see Fig. 2). Two nails are driven into the board, on each side of the tin cover, so as to hold two pieces of fairly heavy wire, between which the fine wire to be fused is attached. It should be arranged so that the middle of it will just touch the top of the heap of magnesium powder.

In order to obtain better results, the powder should be stretched along a length of about 10 inches or a foot on a metal plate. Still better results may be obtained by putting a fairly large cheesecloth screen in front of the flashlight, but then more powder is required. This last method is the one usually employed by professionals.

If desired, the electrical shutter release may b used in connection with this device, and flashlights may then be taken inside in the daytime. The operator simply releases the shutter a few seconds before the exposure, then sets off the flashlight and closes the shutter.

The details regarding the connections are the same as for the shutter release. It will be found, however, that a little less battery will be satisfactory, as the fine wire does not have to be melted, but merely heated red hot.

3. Handy Uses for Electric Lights.

Electric lights are very handy things for the photographer.

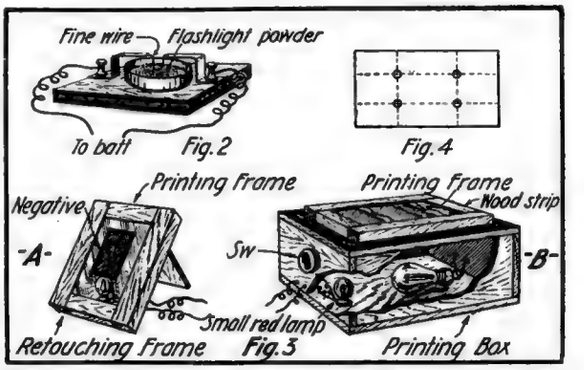
A retouching frame can easily be made, as shown at A in Fig. 3, by taking a printing frame several sizes larger than the negative, and laying it on a table with either part of the back swung out, so that it raises the whole above the table, and gives the surface a slanting position, easy to work on. Then a small electric light bulb underneath, on a piece of white paper, allows one to see the work distinctly. Before retouching, the negative should be treated by painting it with a thin coat of varnish made by dissolving a little rosin in turpentine.

A convenient printing box (see B, Fig. 3) may be made by taking any wooden box of reasonable size (as compared to the size of the printing frame), and cutting a rectangular hole on top, the size of the *opening* in the printing frame. Strips of wood are then nailed on the box so as to closely fit the frame, in this way preventing light from coming out. (This is to permit the box to be used in the dark room.) A Mazda lamp of a size depending upon that of the print is placed inside the box, the connecting wires being carefully brought in through holes, finally packed with putty to prevent light from leaking out. A switch of any convenient type is fastened on the outside of the box, for turning the light on and off.

In use the box should be placed near the developing tray, with the light turned off. A negative is put in the frame, a sheet of printing paper placed on top of this, and the back clamped down over the two. The light is turned on, left on the required time, then turned off. The print is now taken out and developed. As soon as this is completed it is rinsed and dipped into the hypo and another print started. This permits of very fast work, and yet each print is perfect. If desired, a small red light may also be put inside the box so as to help in adjusting the negative over the mask.

A help in developing (when using transparent trays, such as glass or amber composition) is to stand the tray on two strips of wood and put a miniature incandescent lamp (dyed a very deep red) underneath. The formation of the image on the plate, as development proceeds, can then be observed better than with the ordinary dark room lamp.

Another great help in the dark room is a "fountain pen" flashlight, with the little bulb dyed a very deep red. This allows one to get at bottles, trays, etc., lying around on shelves or elsewhere, without having to either grope in the dark or disturb the regular dark room lamp.



Figs. 2, 3 and 4 Showing Several Useful Electrical Ideas for the Amateur Photographer.

4. Taking a Picture of the Wireless Set.

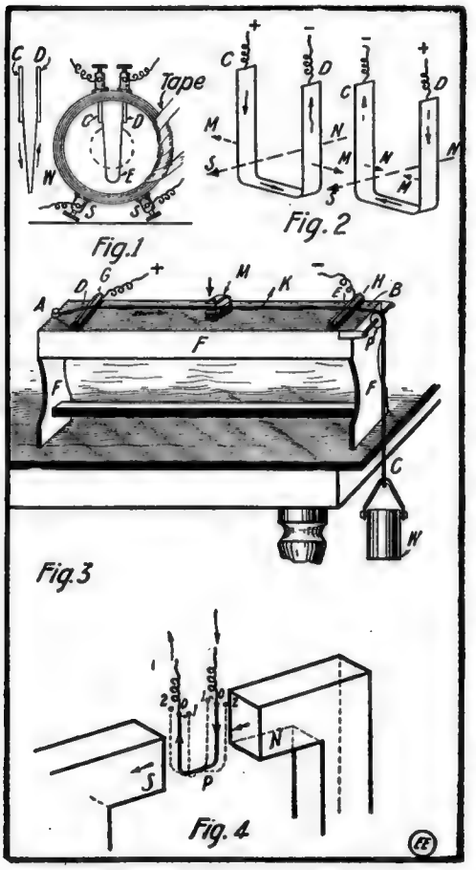
Many an amateur would like to take a picture of his own wireless set, but after the first trial the results are usually so poor (unless he has had a little more experience than most fellows) that he seldom has the incentive to try again.

This is because taking a picture indoors, usually in front of a window, where every-

(*Continued on page* 521.)

SIMPLE ELECTRO-MAGNETIC DEMONSTRATION APPARATUS.

The apparatus described below demonstrates very effectively several important electro-magnetic principles of great importance. The exact dimensions make little or no difference and the cost is very small.



Easily Made Apparatus for Demonstrating Electro-Magnetic Phenomena.

Let us take the instrument as shown in Fig. 1. It consists of a coil about 2½ inches in diameter and made up with 100 turns of No. 24 B. & S. cotton-covered or enameled copper wire. This coil is wrapped all the way round with linen tape, with the exception of a space about 1½ inches long at the top. The coil can be mounted in any manner in an upright position and the ends brought out to two binding posts.

Separate the turns carefully where the coil is untaped and insert the two binding posts with extensions C, D, shown in the illustration. Between the ends of these extensions is fastened a very thin sheet of metal foil. Gold leaf is the best; a piece ¼ inch wide and 2 inches long will do and can be attached to C and D by slightly moistening them and pressing the foil carefully in position. It is advisable to place the instrument in a bell jar or similar arrangement to protect it from draughts.

One or two dry batteries will be sufficient for the experiment. One should be used at first, and more added as found necessary. The one set of batteries may be used for both circuits.

Connect all the batteries to the coil and connect one or two to the posts connected with foil. The magnetic field formed by the coil will pass through the loop at right angles as shown in illustration. If the current is passed through the foil strip as shown by the arrow "F," the loop will open out to form a circle (see dotted lines, Fig. 1). Should the current be sent in the opposite direction, the loop will collapse. This effect can also be produced by reversing the current in the coil.

The current should be shut off immediately when the gold leaf collapses, or the battery will be run down or the gold leaf damaged. Reversing the current for a second will spread the loop again, and it is much better than attempting to open the loop with the hands.

So much for the effect. Now for the cause. This can be best understood by imagining the lines of magnetic force created by the coil as pieces of stretched rubber that have a tendency to shorten and so spread sideways. When current flows in the loop as indicated in Fig. 2, the field inside the loop is strengthened and that outside weakened, and the loop is forced outward to form a circle. The opposite is the case when the current is reversed; the field inside is neutralized or weakened and that outside strengthened, and the two sides are forced together.

Another experiment showing nicely the behavior of a wire carrying an alternating current in a magnetic field may be made by arranging the apparatus shown in Fig. 3. This apparatus is to be used in connection with 110 volts alternating current.

If we mount a copper wire A B C as in Fig. 3, stretching it along some such wooden framework F as that sketched and carrying it over a free-running pulley P to a loading bucket W, we may pass current through a length D E of the wire by making the bridges G H, which hold the wire clear of F, of metal, and using them as terminals. Current taken from lighting mains must, of course, be passed through a 16 or 32 cp. lamp as when charging accumulators, and care must be taken to avoid shocks and short-circuits.

At the center of the wire mount a small permanent magnet M so that its poles lie above and below the wire, but not touching it. When current passes along the wire in the direction shown the wire will be moved electro-magnetically in direction K. If the current be alternating, the wire will swing to and fro in a horizontal direction with the same frequency as that of reversal of the current.

As the apparatus is first set up, it will probably be difficult to observe the vibration of the wire, because the current reverses so often that the wire has not time to move far before it is pulled back again. It is a very simple matter, however, to magnify the motion of the wire so that it becomes very noticeable. The wire thus mounted has a "natural frequency" of its own (indeed, readers who have experimented in sound will recognize this apparatus as the "sonometer" applied to a new use). This natural frequency depends on the material and size of the wire, the length of it between the bridges G H and the tension on the wire. When the natural frequency of the wire is the same as the frequency of the electro-magnetic alternations which vibrate it "resonance" takes place, and the swing of the wire becomes quite considerable. The most convenient and gradual way of varying the natural frequency of the wire (so as to "tune" it to the supply frequency) is to increase the tension on the wire by pouring water into the bucket W. Using 2 or 3 feet of No. 24 copper wire between G H, Fig. 3, it will generally be found that a two-quart can is a suitable size to hang on the wire at C, assuming 60 cycles per second alternating current to be employed. Having switched on current, pour water slowly into C till the swing of the wire attains a maximum. Variations in the supply frequency will then be shown by variations in the width of "blur" made by the quickly moving wire. It is possible, but not easy, to calculate the supply frequency from the length, size and load of wire with which resonance is attained.

The same phenomenon of electro-magnetic vibration may be demonstrated in another effective way, and without making any special apparatus, by placing between the poles of a direct current electro-magnet or permanent magnet, or between two bar magnets in "series," an electric glow lamp supplied with alternating current and having one or more loops of filament, which loops are now placed *parallel* to the magnetic field and not perpendicular thereto as in our first loop experiment. Referring to Fig. 4, it is clear that when current flows as shown the filament loop O P O will tend to twist in the direction 1 P 1; and when the current is reversed the loop will tend to move to 2 P 2. If lamp current and magnet field be reversed simultaneously (by connecting lamp and magnet coils in series) the lamp filament will remain stationary. In the lamp the points OO of the filament are fixed; but if the lamp is a high voltage, low candlepower lamp—i. e., if the filament is long and slender—it will twist very appreciably (sometimes through 30 degrees or so) under the action of the alternating electro-magnetic forces. This will give the appearance of a broad, bright band at the sides of the loop, the point P (Fig. 4) remaining stationary. A very pretty effect is obtained by using a three-loop lamp. If the filament be wound in the shape of a drum, or in any other shape than a U-loop or number of parallel loops, its motion in the alternating field will be complex, but very interesting. Some lamps will show the vibration better than others, and the filaments which vibrate through the widest angle will break soonest. (This particular experiment is not calculated to reduce lamp bills, and is apt to be unpopular on that account.)—*Junior Mechanics and Electricity.*

AN ELECTRIC TRAP FOR CATS, ETC.

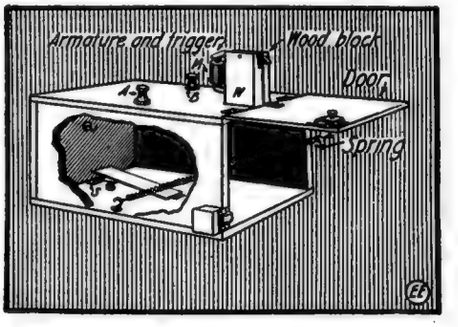
The electric circuit through this trap is as follows: From binding post A, through contact spring S, through one hinge of door to upright W, then through trigger and armature, through electro magnets M, and then to binding post B.

The contact spring may be placed on bait Hook if desired instead of under board.

This is a very efficient trap, as the contact is so much more easily closed than the *figure-four trigger* or any other kind. The trap will serve as well for birds as for animals.

Battery is connected to binding posts A and B. There are no dimensions given, as the trap can be made in any desired size. For large traps an ordinary electric door opener will do very well for a trigger. Contributed by

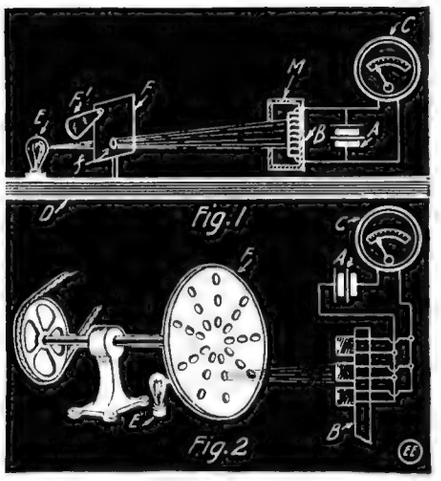
J. E. HENDERSON, JR.



Simply Constructed Trap With Electrical Release Magnet for Door.

A SELENIUM PHOTOMETER.

The inaccuracies of the photometric methods now in common use are well known. In many cases differences amounting to as much as 10 per cent. will exist between the estimates made by different observers with best available scientific means of comparison. Furthermore, the colors of the lights to be compared are of great importance. The colors differ in the intensity of the effect produced upon the eye of an individual, and there is a marked variation between different persons in this respect. By some observers two lights of the same color may be compared with considerable accuracy, but a change in the color of the standard with the common standard of comparison (the now well-known "Pentane Lamp") will render the determination worthless. The color of the standard lamp is toward the red end of the spectrum, and to most eyes it shows decidedly pink. Hence, when an attempt is made to compare a yellow incandescent lamp, for example, with the standard, the results obtained from different observers are often so discordant as to make them of little use.



Simple Form of Selenium Photometer.

To obviate all these difficulties William J. Hammer has devised and patented a very simple and ingenious photometer in which the sensitivity of selenium to light is practically applied.

In Fig. 1 A is the battery connected in a circuit with a selenium cell B, which is preferably of that form in which the selenium, after being coated upon a suitable conducting support, such as a coil of nickel wire, is sealed in a tube of nearly perfect vacuum. C is a measuring instrument, being in the case illustrated a milli-voltmeter, responsive to small variations of electrical pressure.

Upon a suitable table D is arranged the lamp E to be tested. At F is a screen having a hole f, which may be closed by a slide F_1; in practise it is preferable to place the selenium cell in a light, tight box M having free ventilation, so that the indication may not be affected by exterior light.

The method of operating the arrangement thus described is as follows: A standard lamp of any desired construction is placed in a proper position adjacent to the apparatus lighted, being screened, completely from the cell B. A small current is then caused to flow in the circuit, including the selenium cell, and after it has attained a steady value the fall of potential around the cell is measured by the milli-voltmeter. After this the light of the standard lamp is allowed to fall upon the cell, and the change in the resistance of the circuit (as indicated by the change in the voltage drop), caused by the action of the light upon the selenium, is measured and recorded; this then becomes a constant for the particular "cell" employed. After this the light which is to be compared with the standard may have its specific effect upon the cell determined in the same way. Obviously, the indication of the cell for the first specimen constructed must be calibrated by comparison with the results obtained by photometers, since the measurements of light now in use are purely arbitrary and have no relation to any definite physical quantity; but this relation having been once established in the manner indicated, may be indefinitely perpetuated by periodic comparison of different cells to guard against change.

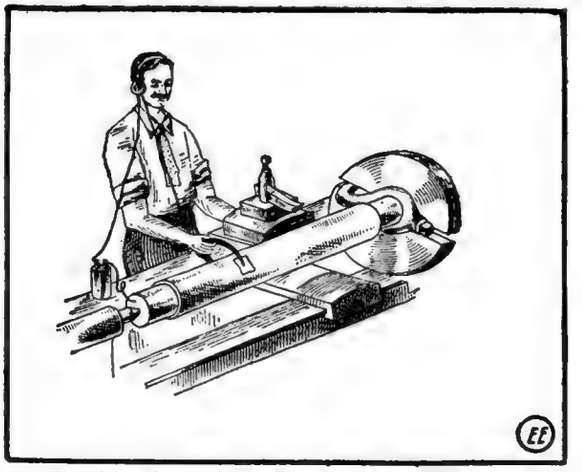
Another good arrangement is shown in Fig. 2. In this figure the cells B are arranged upon a stationary support and the screen disc F alone rotates, cutting off and admitting the light periodically by its rotation. This construction is cheaper, and yet substantially effective. This is another practical use of selenium.

Contributed by
HOMER VANDERBILT.

TELEPHONE RECEIVER AIDS THE MACHINIST.

A telephone receiver has been my constant friend about the plant for the past 12 years, says A. J. Carr, in *Power*, I use it for various purposes, one of which is in connection with calipering, especially the work inside of engine cylinders. The most convenient way is to have the two sides of the calipers insulated from each other. In the illustration, where the work in the lathe completes the circuit, causing a click in the receiver, an ordinary pair may be used with a cigarette paper between the work and one side of the calipers. This method is especially useful in aligning engines.

Use a slender German silver wire for the "center" line, taking care that it is insulated from the ground if an ordinary caliper is used, or put a cigarette paper next to the cylinder wall; then, with one side of the circuit connected to the aligning wire and the other to the calipers, a circuit will be completed when the two come in contact. A click will be heard when a contact is so slight that it cannot be seen or felt. Care should be taken not to use too much battery power, as it is annoying to the ear.



Telephone Receivers Aid the Machinist to Calliper.

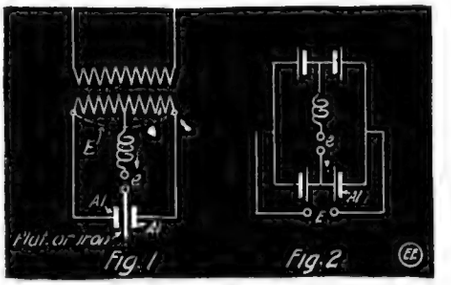
Brass Cleaning Paste.—The following makes a good cleaning paste: *Rotten Stone*, 6 ozs.; *Oxalic Acid*, 1 oz; equal parts of *Whale Oil* and *Spirits of Turpentine* sufficient to make a paste.

A general metal polishing paste may be made as follows, the quantity of the parts being by weight: *Petroleum Jelly* (white), 90 parts; *Kieselguhr*, 30 parts; *Refined Paraffine Wax*, 10 parts: *Refined Chalk* or *Whiting*, 10 parts; *Sodium Hypophosphite*, 8 parts. A little *Citronelle* can be added to cover up disagreeable odors and scent to paste.

A polishing powder may be made as follows, the quantities being by weight: *Putty Powder*, 14 parts; *Pipe Clay*, 14 parts; *Kieselguhr*, 42 parts; *Tartaric Acid* (powdered), 1½ parts.

ALUMINUM RECTIFIER EFFICIENCY

In a recent article Günther Schulze discusses what maximum efficiencies may be expected from electrolytic rectifiers with aqueous solutions. The efficiency is limited by three kinds of losses. The first loss is due to the fact that a certain minimum voltage must be reached before the current will pass in the permissible direction. This minimum voltage is a function of the formation voltage of the aluminum plates. The second loss is caused by the ohmic resistance, and the third by the fact that the impermeability of the rectifier (in the direction opposite to the permissible direction) is not perfect. The last two losses may be made small, but the first loss due to the minimum voltage cannot be reduced at will. The author makes the calculations for two arrangements of the rectifier. The first, shown in Fig. 1, is the transformer system in which *E* is the transformer and *e* is the available direct-current voltage. *Al* represents the aluminum plates, and between them is a platinum (*Pt*) or iron (*Fe*) plate. The second system discussed is the Graetz system, shown in Fig. 2, in which *E* is again the alternating voltage and *e* is the available unidirectional voltage. In both cases an induction coil is inserted in the direct-current circuit to make the voltage practically constant. The author first determined the minimum voltage as function of the formation voltage for different electrolytes and calculated the maximum voltage obtainable both for the transformer system and the Graetz system. In both cases the possible efficiencies reach a maximum which is from 80 to 85 per cent., but this maximum is reached for a unidirectional emf. of from 60 volts to 80 volts for the transformer system and for from 100 to 150 volts for the Graetz system. For small voltages the maximum possible efficiencies are low. For a unidirectional emf. of five volts the maximum possible efficiencies are about 40 per cent. for the transformer system and only 25 per cent. for the Graetz system.—*Archiv. f. Elek.*, Vol. 3, No. 1, 1914.



Two Methods of Connecting Up Electrolytic Rectifier.

HOW TO MAKE IT

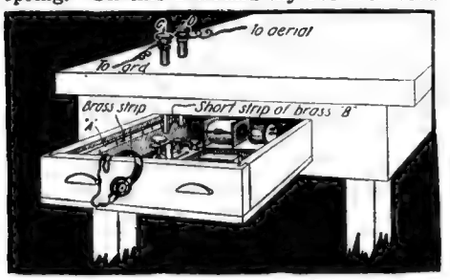
This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

RADIO SET IN TABLE DRAWER.

The diagram represents a scheme which I have worked up and would like to contribute to the "How to Make It Department." As I wanted my receiving set near at hand and yet ordinarily hidden from sight and protected from dust, I hit upon the following plan:

I took out my top bureau drawer, and after cleaning and sandpapering I gave it a couple of coats of black shellac. I then fastened my various instruments to the bottom in the most convenient way. Along the inner top edge on one side of the drawer I fastened a thin strip of copper "A" on a ⅛-inch piece of pine as shown in the diagram. This was separated about ½ inch from the aerial plate "B," also fastened on side of drawer as shown. Two binding posts "C" and "D" were screwed through the top of the bureau, as close to the inside of the drawer as convenient. On the under side of these binding posts (which were parallel to the side of the bureau) two copper strip brushes were fastened and bent so that they would brush against the strip on the side. The different instruments I connected up as usual. When the drawer was now closed the aerial was automatically *grounded*, and when the drawer was pulled out as far as possible the aerial was connected to apparatus ready for use. In one corner of the drawer I arranged a large twine spool with an old alarm clock spring. On this I wound my receiver cord



Mounting Radio Set in Drawer Makes It Dust and Fool-Proof, Besides Being Quickly Connected.

so that it would be wound up normally. In this way it takes me only a second to get my set ready for use, although it is not exposed to dust or to my younger brother's fingers.

Contributed by F. J. BACHMANN.

POINTERS ON STORAGE BATTERIES.

The following are some miscellaneous pointers on storage batteries:

Restoring weakened cells. There are several methods of restoring cells that have become low.

1. Overcharge the whole battery until the low cells are brought up to the proper point. 2. Cut the low cells out of the circuit during one or two discharges and in again during charge. 3. Give the defective cells an individual charge.

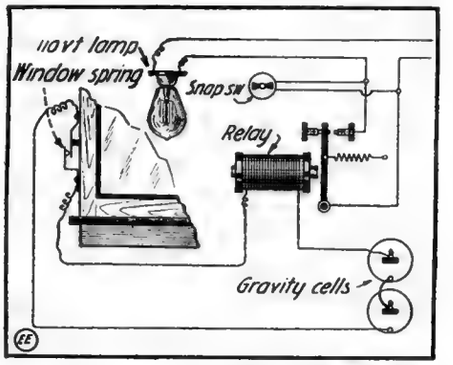
Idle batteries. If a battery is to be idle for, say, six months or more, it is usually best to withdraw the electrolyte as follows: After giving a complete charge, siphon or pump the electrolyte into convenient receptacles, preferably carboys, that have never been used for any other kinds of acid, and that have been thoroughly cleaned. As each cell is emptied, *immediately* refill it with water. When all the cells are filled, begin discharging and continue until the voltage falls to or below 1 volt per cell at normal load, and then draw off the water.

Contributed by EDW. CONNELLY.

SECOND PRIZE $2.00.

BURGLAR ALARM THAT TURNS ON LIGHTS.

A very reliable, closed circuit burglar alarm may be made from the following articles: Two or three gravity cells for battery, some closed circuit door and win-



Scheme for Burglar Alarm Relay to Turn on Lights.

dow springs, some double cotton covered wire, an old telegraph relay and some regular electric light wire. The relay and gravity cells and contact springs are set up in the usual way, for an ordinary closed circuit system, but instead of using dry cells and electric bells in the local circuit two wires are run from the lighting switch wires in such a manner as to connect the relay in parallel with the snap switch. The system works like this: Before going to bed as many lights as desired are left on and then turned off by the regular snap switch. If during the night an intruder should raise one of the windows or open a door, or even cut the wires, the circuit would be broken and this would allow the magnets to release the relay armature. Of course, as soon as the armature was released a contact would be made and the lamps would light up; current finding its way to the lights through the relay instead of through the snap switch. As everyone knows, a burglar is afraid of light and consequently he would be scared away before he even got into the house.

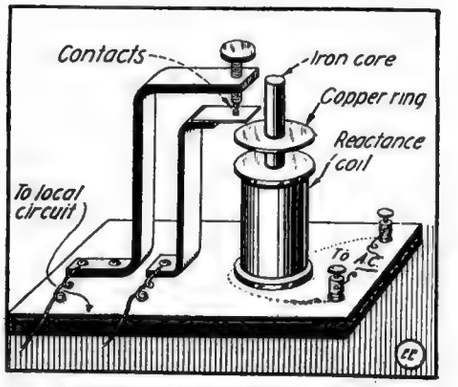
Contributed by GEORGE M. GILBERT.

THIRD PRIZE $1.00.

A NOVEL A.C. RELAY.

This relay can be constructed by anyone wanting a relay for handling heavy currents. First a core of transformer iron is procured. This should measure ½x½x6 inches. Around the core is wrapped two or three layers of friction tape. Then wind 135 turns of No. 11 D. C. C. over this. Wind a layer of tape around this and then a piece of empire cloth. Cover the cloth with shellac after it is on so that it has a smooth surface. Next procure a piece of about No. 20 B. & S. gauge copper sheet. From this is cut a circle 4 inches in diameter with a hole 1 inch in diameter in the center. Two supports are required for the contacts. These comprise two pieces of brass strip, one 9 inches and one 8 inches long, tapped 8/32 at each end. A bend is made at the top of the 9-inch support as shown, and a set screw with a silver contact placed on the end of it. To the 8-inch support a piece of spring brass with another silver contact is secured. These supports extend above the copper ring which is placed over the end of the reactance core. Now place the coil on its end, and firmly mount it. Next place the copper ring over the core. When the current is turned on, the copper ring jumps up and closes the contacts

Contributed by ROBERT CHANDLER.



An Alternating Current Relay. The Copper Ring is Repelled Upward, Closing the Contacts.

WAVES OF LIGHT AND ELECTRICITY.

There is a close similarity between light waves and the Hertzian waves employed in wireless telegraphy. The latter are subject to reflection and refraction, like light. Electrical waves will pass through many substances quite easily, while they are stopped by a sheet of metal. In a similar manner some materials are transparent to light waves, while others are opaque. It is now generally admitted by scientists that all forms of radiant energy—heat, light, Hertzian waves, etc.—are essentially the same, being of an electro-magnetic nature.

AN AUTOMATIC BATTERY CHARGING PANEL.

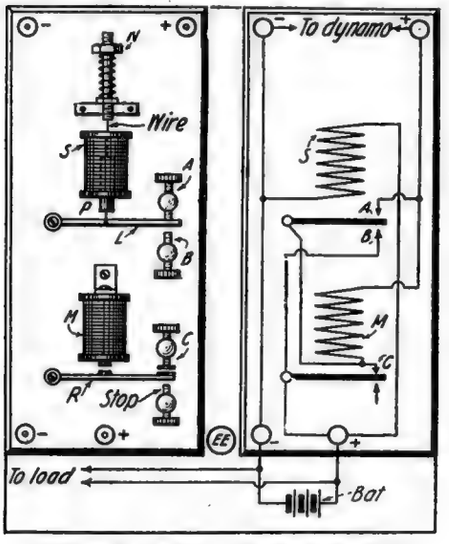
This is a simple device that will automatically switch on and off the charging current for storage batteries.

When batteries are discharged the drop in voltage will cause the soft-iron plunger P and lever L to drop away from the solenoid S, which is shunted across the terminals of the battery. Upon touching contact B the lever L closes the circuit for the charging current, which flows through magnet M, attracting armature R and closing the heavy copper contacts at C. These heavy contacts at C are to take care of any arcing that might occur should the charging current be broken by the smaller contacts at B.

When the battery is fully charged the effect of the rise in voltage will draw the plunger up into the solenoid S until lever L touches contact A; this short-circuits magnet M, causing the armature R to drop and open the charging circuit.

Solenoid S is wound with fine wire to the resistance of 120 ohms (one pound of No. 28 S. C. C. wire) for a 6-volt battery. Magnet M is wound with No. 16 S. C. C. wire (three layers).

After the battery is fully charged the first time the device must be adjusted by



Automatic Battery Charging Cut-Out.

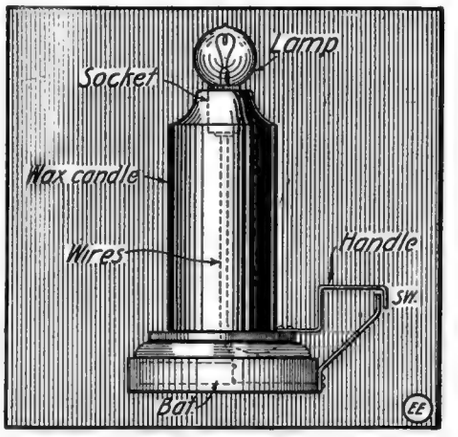
regulating nut N, which controls the pressure of the spring directly under it, and contact A. In like manner adjustments of contacts B and C are necessary when battery is in discharged condition.

If the load on the storage battery consists of any apparatus, such as lamps, etc., that cannot stand the gassing voltage of the battery (which is about 2.5 volts per cell) the idle contact marked "Stop" can be used to open the circuit marked "To Load" while battery is being charged. Contributed by ALBERT F. MURRAY.

A CHEAP ELECTRIC CANDLE.

An interesting and novel manner of transforming an ordinary wax candle into an electric one deserves consideration. It will prove invaluable in dark rooms and at night, where others grope around in darkness. It may also prove surprising that candles (though more elaborate) such as described here are retailed at prices ranging from $3 to $4.

A wax candle is first procured. At the top of the candle bore a small hole with a penknife, leaving a hollow opening into which the electric socket is later to be placed. The wick is pulled out entirely. This process leaves a hollow and empty center, into which the wires are run. The socket is slipped in at the top and wires are



Cheaply Made Electric Candle.

inserted through the center space where the wick formerly was.

Next obtain a hollow base of wood, which may be of circular shape. In the center of this base is drilled a small hole to admit the wires from the socket to be connected up to battery. A flashlight battery is necessary and the two wires are soldered to same, one to carbon, the other to zinc. A suitable handle is fastened to the base, wherewith the candle may be easily held in the hand. If desired the electric current may be controlled by a switch conveniently located, or the electricity supplied by the battery can be cut off by simply unscrewing the electric lamps in socket.

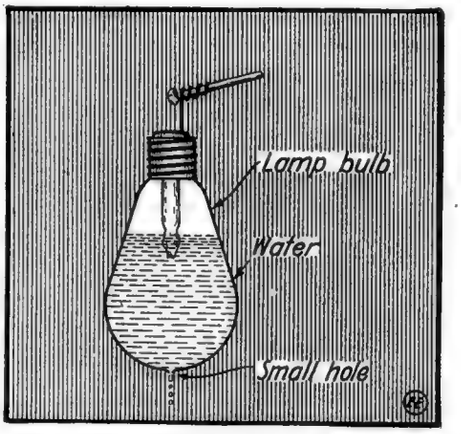
Contributed by WM. WARNHAM.

AN ELECTRIC BULB BAROMETER.

It is an easy matter to convert a burned-out, incandescent light bulb into a barometer that will foretell changes in the weather with remarkable success.

Place a discarded bulb under water in a deep basin, and after protecting the hands against danger from broken glass, break off the pointed bit of glass at the very end of the bulb with a pair of pliers. As soon as an opening is made in the glass the bulb will fill with water, which rushes in to take the place of the vacuum.

Tie a cord or stout string about the neck of the bulb and hang it on a hook or nail.



Barometer Constructed from Electric Lamp Bulb.

If the weather is to be fine, no water will drop from the hole at the bottom of the bulb. When the water begins to bulge out of the opening until drops fall from the bulb, you may expect a change in the weather.

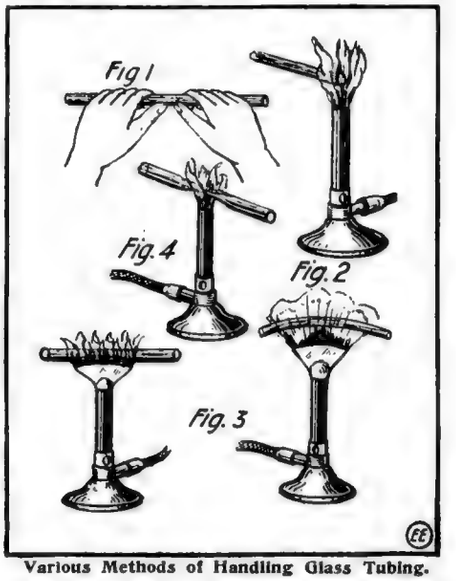
Atmospheric pressure governs the action of this simple barometer. When the pressure increases—a sign of fair weather—it pushes the water back from the mouth of the bulb, and no drop can form; when it falls, the water expands through the opening, until a few drops fall. As lower pressure nearly always precedes a change of weather, a drip from the bulb usually indicates a coming storm.

HOW TO HANDLE GLASS TUBING.

To break small glass tubes simply make a small file scratch on one side and then grasp the tube on each side of the scratch, placing the thumb nails together opposite the scratch and pull back. By using this method the tube will break evenly. (Fig. 1.)

Never leave the rough edges on the ends of the glass tubes, as it is dangerous and may result in cuts on the fingers. To round off the edges place in a gas flame (as from a bunsen burner) and allow the tube to remain until it becomes red hot, when surface tension will round off the edges. (Fig. 2.)

When bending glass tubing it is best to use a "fish-tail" burner, a burner giving a long flattish flame. When this kind of a burner is utilized the bend will be round



Various Methods of Handling Glass Tubing.

rather than angular and hence will be better, as angular bends are more likely to break, besides obstructing the flow of a liquid. Place the tube in the flame and turn it slowly, so as to distribute the heat uniformly. When the glass begins to redden stop turning and hold the tube by one end only. Leave the tube in the flame until it bends to the right angle. Always let gravity do the bending, as it is much more uniform and steady than bending by hand. Care should be taken to have the two sections in the same plane. (Fig. 3.)

Glass tubes can be closed by heating the end until it is very hot and then keeping it in a molten state for some time. The surface tension will gradually decrease the hole until it finally closes. Tubes can also be closed by pulling them apart. They should be heated to a cherry red color and then pulled gently on each end until they separate. (Fig. 4.)

In heating all glass care should be taken that it is perfectly dry, as any moisture is liable to crack it. Always heat gradually at first, and also let it cool gradually. Never try to heat real thick glass because, glass being a poor conductor of heat, it expands unevenly and is likely to break.

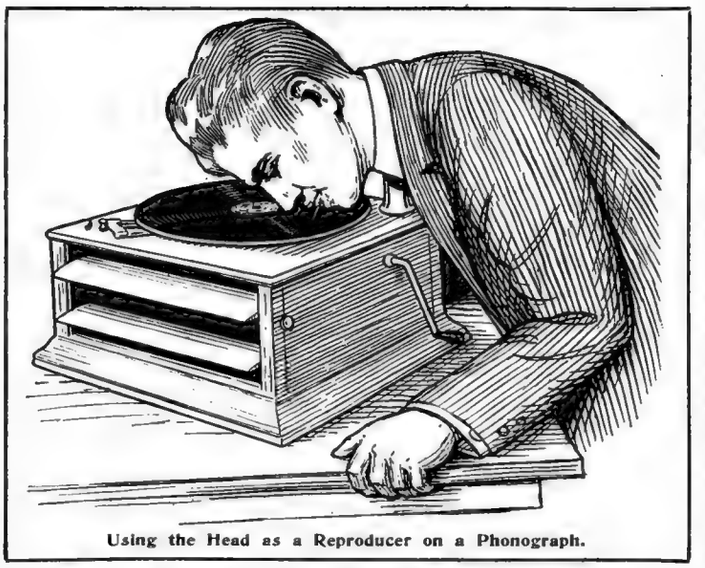
Contributed by KENNETH SUTTON.

Hearing Through Your Teeth

By H. Gernsback

THE following interesting experiment can be performed by anyone who has an ordinary disc phonograph. It is interesting, in so far as it shows the transmission of sound through the teeth, and through the bony substance of the human skull, which in turn reacts upon the auditory nerve. It is not well known but it is a fact nevertheless that sounds do not necessarily have to enter through the oral opening in order that we can hear sounds. Physicians in testing for hearing sometimes use a tuning fork which, after struck, is pressed with its lower part against the back of the skull, right behind the ear. The sound is then heard inside of the head the same as if it had actually entered through the opening of the ear itself. This principle is made use of in the experiment described here, and while it is not electrical by any means, it probably will interest every experimenter who owns a phonograph.

Stop up both of your ears with cotton as tightly as possible so that no sound will be heard from the outside. Now place an ordinary darning needle between your teeth by biting on it hard, taking care at the same time that the lips or tongue do not touch the needle. The latter is important because if either lips or tongue touch the needle the sound will be decreased considerably. For best results the needle itself should project not more than 1 or 1½ inch from the mouth. For that reason the darning needle should be broken off about one and one-half inches from its sharp point. It goes without saying that the sharp point should project out of the mouth while the broken off end should be inside of the mouth.



Using the Head as a Reproducer on a Phonograph.

Now start an ordinary disc phonograph and carefully press down upon the record with the needle's point held at the same angle as the reproducer's needle is held ordinarily. With a little practise one will become proficient in moving the head at the same ratio of speed as the ordinary reproducer arm is moved from the outside of the record towards the inside. As soon as the needle touches the record with sufficient pressure, the inside of the head will be filled immediately with music exceedingly loud and clear.

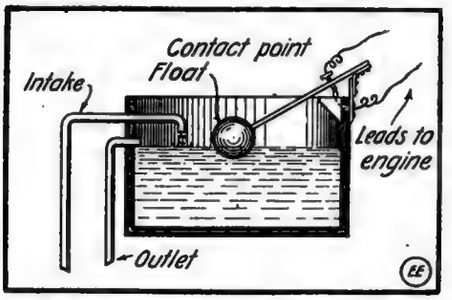
A curious result of the experiment is that a person standing near by can hear the music, the head acting as a reproducer in this case.

Of course, it will be understood that a totally deaf person will not be able to hear any sound if the auditory nerve is dead or inactive. It is, however, interesting to note that *partly* deaf people can hear the music quite well. This is particularly true of persons hard of hearing who cannot ordinarily hear the sounds of a phonograph.

The writer should like to hear from readers, particularly from those who are partly deaf, who have tried this experiment; *The Electrical Experimenter* will be glad to publish the results in subsequent issues.

AUTOMATIC STOP FOR PUMPING STATIONS.

The following is a suggestion to those who have pumping stations using gasoline or oil engines to pump the water into a tank. A great deal may be understood from the cut, but a little explanation may



Pumping Engine Cut-Off Switch Equipped With Float.

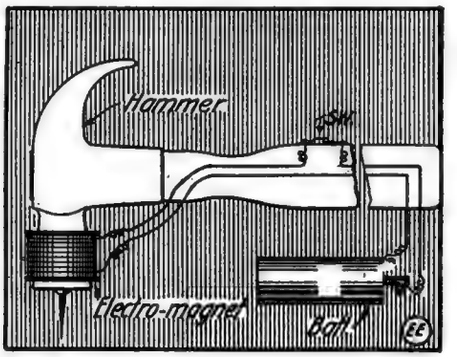
be necessary. On the side of the tank, just above the level of the outlet, is placed a triangular block of wood to which is fastened a contact point of suitable size, with a wire leading to the outside, and just above this is placed a shaft, which is hinged to the side of the tank and has a float at the end of it. A contact point on the end of an adjusting screw is put through the shaft vertically and is connected to another wire leading to the outside. The adjusting screw is put so that when the water is down it will rest on the other contact, and when the water rises to the overflow outlet the shaft rises and breaks the contact. The wire leads go to the engine (the negative one may be grounded to the water pipe if desired) and are connected in series with the batteries or magneto.

As soon as the water rises and fills the tank the contact is broken; the ignition current ceases to go to the engine and it stops, thus saving the waste of water and gasoline and making it unnecessary for anyone to keep watch over it.

Contributed by W. F. ALLSTON.

ELECTRO-MAGNETIC HAMMER.

Obtain a hammer, and if the end or tip of the hammer head is rusty, clean off the rust by using a piece of emery paper. Wind on five or six layers of No. 18 magnet wire. Leave leads on the magnet for about 6 inches. Take a small piece of brass (from a small flashlight battery) and bend as shown in diagram for a switch. With some small staples tack the wire firmly on the hammer handle and connect with the switch. Bring the wires to the end of the handle and tack them down firmly, leaving a few inches to connect with some flexible cord. A connector should be placed in the circuit, so that when the batteries are not



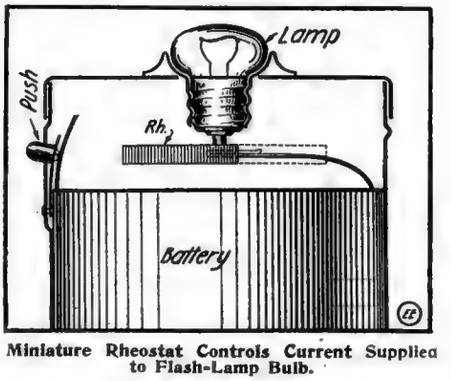
An Electro-Magnetic Hammer Proves Useful in Handling Small Nails, Tacks, Etc.

needed the cord will not be in the way. This hammer will work on three or four batteries nicely. Contributed by

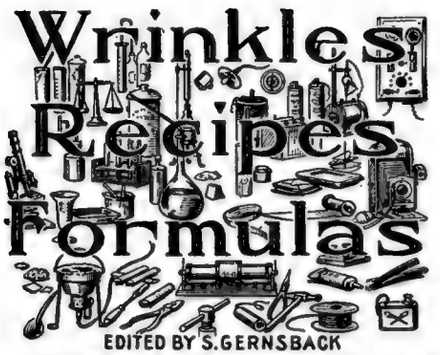
WALTER BRAHANEY.

GERMAN FLASHLIGHT HAS RHEOSTAT.

A unique, adjustable type of pocket flashlight has been developed for use in the German army, and it is useful in giving different kinds of signals, etc. The flashlight is shown schematically in the drawing herewith. It does not differ in a general way from those with which we are familiar, but the lamp may be lighted with different degrees of brilliancy by the use of the adjustable resistance coil placed against the back of the lamp. This coil is made to slide back and forth on the brass connecting lug from the battery as perceived. This is also of service in compensating for the drop in voltage of the batteries if a lower than normal voltage lamp is employed. It is, of course, apparent that if such a below normal lamp is employed, that it would undoubtedly be burned out in short order by a fresh battery. Hence, some of the resistance may be cut in, in this event, and as the battery voltage falls, after it has been used awhile, some of the resistance may be cut out; thus keeping the voltage on the lamp approximately constant.



Miniature Rheostat Controls Current Supplied to Flash-Lamp Bulb.



EDITED BY S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 17.
Composition of All Kinds.

1. *Flexible Insulating Mass.*—Forty parts of *Shellac;* 40 parts of dry, finely pulverized *Asbestos, Flax Cotton, Wood* or *Paper;* 25 parts of *Wood Tar;* 1¼ part of *Paraffine.* Mix together in a vessel at 100 to 200 degs. F.

2. *Gutta Percha Composition.*—Six parts of *Gutta Percha;* 2 parts of *Bone Dust;* 1 part of *Pipe Clay.*

3. *Insulating Compound.*—One part of Stockholm *Tar;* 1 part *Resin;* 3 parts of *Gutta Percha.*

4. *Composition for Mouldings, Frames, Etc.*—Twelve parts of *Whiting;* 6 parts of fine sifted *Sawdust;* 1½ parts of *Linseed Oil Cake.* Knead this mass to a paste with a strong solution of glue.

5. *Another.*—Eight parts of *Pulverized Litharge;* 16 parts of *White Lead;* 2 parts of fine *Sawdust;* 20 parts of *Plaster of Paris.* Stir these ingredients into 26 parts of glue dissolved in sufficient water.

S. G.

POISON PREVENTER.

The following will be found a useful prevention from taking poison by accident: In the cork of the bottle insert some pins so that they extend above the cork slightly and are thus exposed. Cover the cork with these except a small space so that the fingers can hold the cork without being pricked. The idea is that when a person takes hold of the cork of this bottle in the dark they invariably will be pricked by the pins, which warns them that the bottle contains poison. Contributed by

ANDREW W. GALLAGHER.

A GOOD WRITING FLUID EASILY MADE.

A good writing fluid, of a rich, dark black, can be put up by following this formula:

Two and four-tenths grams of logwood extract, should be mixed with 100 cubic centimeters of distilled water. Heat should be applied until the substance is dissolved. After it is cooled potassium chromate should be added, until the desired shade is attained. From 2 to 3 c.c. is usually sufficient. A little gum arabic, or gelatine, may be dissolved in the matter to give it a good consistency, or "body."

If this method is followed the solution should then be filtered through silk. This finishes the fluid, and it is ready for use.

For Users of Fountain Pens.

I have always had great difficulty in unscrewing my fountain-pen for refilling. I found out, however, that if the threaded piece of the pen is slightly greased with a little vaseline the parts will unscrew much easier, and the contained ink cannot leak out, thus eliminating soiled fingers.

CHEMICAL BAROMETER AND FLASHLIGHT POWDER.

To make a chemical barometer take potassium nitrate, 30 grs.; ammonium chloride, 30 grs.; camphor, 120 grs.; alcohol, 2 ozs. Put the mixture in a bottle ten inches long and ¾ inch in diameter. Cover the bottle with a piece of perforated plaster. If fine weather is indicated the insoluble matter will settle at the bottom of the bottle; previous to a change for rain the compound gradually raises, the fluid remaining transparent. Twenty-four hours before a storm or very high wind the substance will be partly on the surface, the fluid being turbid and in a state resembling fermentation.

Flashlight powders: Take powdered magnesium, 3 ozs.; powdered chlorate of potash, 6 ozs.; powdered sulphide of antimony, 1 oz. Mix by sieving. One hundred grams to be used each time a photograph is taken.

Contributed by

RICHARD GAILLARD.

MAKING A HECTOGRAPH.

As the price of a good printing set is usually beyond the means of the average experimenter, the following device will not be found amiss as an excellent substitute:

First obtain a shallow tin dish (the cover of a bread box will answer the purpose well), an ounce bottle, an ounce of gelatine, 1 ounce of brown Demerara sugar, 6 ounces of glycerine and 2½ ounces of barium sulphate. Break the gelatine into small pieces and place in a sauce-pan with 3 ounces of water and let this steep overnight. Next pour in the glycerine and heat over a fire. Put in the sugar and let it heat until dissolved. Then take the barium sulphate and mix with 1 ounce of water in a separate cup. Pour this into the sauce-pan, and when thoroughly mixed pour it into the flat tin dish (which should be well cleaned) and then allow the mass to harden.

Buy some hectograph ink, or make it at home by filling an ounce bottle with 2 drachms of methyl-violet aniline and 2 drachms of spirit and dissolve it in 1 ounce of water. Write on a piece of paper whatever you want to reproduce, and place the paper, face downward, on the rubber-like surface, rubbing same gently on the written matter. After one-half to one minute, pull the paper off. Then take another paper and press upon the hectograph, and it will be reproduced as many times as you repeat this operation.

To clean the hectograph wash it first with water, mixed with an eighth part of hydrochloric acid, also known as spirit of salt; then clean the surface with pure water. Let it stand for 12 hours before using again. Contributed by

H. J. GUTHRIE.

A Bright Polisher.

A few grains of butter of antimony added to a bottle of ordinary machine-oil proves to be an excellent polisher for old furniture. It is easily made and brightens wherever applied to.

Contributed by W. W. J.

To Clean Brass.—An economical method of cleaning brass is to rub it with a mixture of *Vinegar* and *Salt,* or *Oxalic Acid,* then wash with *Water* and polish with *Tripoli* and *Sweet Oil.*

Another liquid polish for metal is as follows: *Jewelers' Red,* 25 parts; *Oil of Turpentine,* 15 parts; *Oil of Stearine,* 25 parts; *Animal Charcoal,* 45 parts; *Alcohol* sufficient to make the mass practically liquid. Apply with a brush. After the alcohol has evaporated rub with a cloth.

HOW TO PUT A PIANO FINISH ON WOOD.

If the wireless man wishes to finish his instruments or table with a finish which will not only last indefinitely, but closely rival the finish on his piano, the following process must be closely adhered to. The method described below is that which the manufacturers of fine pianos use.

1. Sandpaper the wood thoroughly with fine sandpaper. Do not sandpaper across the grain.

2. Use oil stain or dye. Put on heavy and wipe off surplus.

3. Next put on a good wood filler. Rub filler into the wood with excelsior. The pores of the wood should all be filled. Rub across the grain.

4. Sandpaper very lightly.

5. Give three coats of shellac. Thin white shellac is preferable. Sandpaper each coat when the shellac is dry before applying the next coat.

6. After the last coat of shellac is sandpapered apply a coat of the very best grade of varnish obtainable. Sandpaper this coat when dry.

7. Apply another coat of varnish. When *thoroughly dry* rub with *coarse* pumice stone. The pumice stone is put on *wet felt* and rubbed hard until the wood is entirely free from lumps and perfectly smooth. Wipe off all traces of the pumice stone with a wet rag or chamois skin.

8. Give the last coat of varnish.

9. Rub with *fine* pumice stone in the same manner as with the coarse, but do not rub as hard or as long. Rub just hard enough to take off any lumps which the varnish might have left. Wipe off any of the pumice stone remaining.

10. Rub with rotten stone in the same manner; that is, very lightly. Rotten stone is sold in small cakes about the size of your fist and is likewise applied with wet felt. Wipe the wood clean and let it dry.

11. Now rub with the palm of your hand. Rub hard until the wood is clear and smooth. You will now have a mirror-like finish. The wood becomes slippery after the hand rubbing and will not catch the dust.

In applying the varnish and shellac put on a thick coat roughly. Then use long sweeping strokes with a fine brush. Always wait until the varnish is dry before sandpapering. See that the varnish is always thin and plastic before applying.

Contributed by CARL A. HENLEIN.

RECIPES FOR JEWELERS' ENAMELS.

Melt together the combinations of materials as given below to make the various colors of enamel. Portions by weight.

Transparent Red—Cassius gold purple, 65 parts; crystal glass, 30 parts; borax, 4 parts.

Transparent Blue—Crystal glass, 34 parts; borax, 6 parts; cobalt oxide, 4 parts.

Dark Blue—Crystal glass, 30 parts; borax, 6 parts; cobalt oxide, 4 parts; bone black, 4 parts; arsenic acid, 2 parts.

Transparent Green—Crystal glass, 80 parts; cupric oxide, 4 parts; borax, 4 parts.

Dark Green—Crystal glass, 30 parts; borax, 8 parts; cupric oxide, 4 parts; bone black, 4 parts; arsenic acid, 2 parts.

Black—Crystal glass, 30 parts; borax, 8 parts; cupric oxide, 4 parts; ferric oxide, 3 parts; cobalt oxide, 4 parts; manganic oxide, 4 parts.

White, 1—Crystal glass, 30 parts; stannic oxide, 6 parts; borax, 6 parts; arsenic acid, 2 parts.

White, 2—Crystal glass, 30 parts; sodium antimonate, 10 parts. The glass used for this one must be free from lead.

Contributed by JOHN McCAFFERY.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

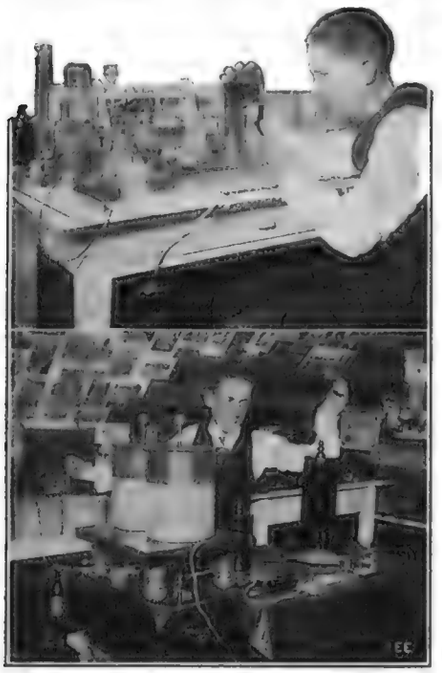
AMATEUR RADIO STATION CONTEST.
Monthly Prize, $3.00.

This month's prize winner.

E. JACOBSEN'S LABORATORY.

During my spare time I do considerable experimental work and am sending you some photos of my laboratory. I haven't any good photos at hand at the present time, so I am sending you just what I have available. I am going to high school at present and don't find much time for taking and finishing photos.

The views herewith show part of my photographic and chemical laboratory, also a flashlight of my "high tension" apparatus When this photo was taken I cut down the length of the high frequency spark from 12 to 6 inches, so that I could get a better picture.



Above: Edwin Jacobsen in his Chemical "Lab." Below: Taking Sparks from His Tesla Coil.

I am always interested in seeing pictures of other laboratories published in the *Electrical Experimenter*, so that is the reason I am sending you these. I would say that most of my "lab' is located in the attic and that accounts for the slant to these pictures.

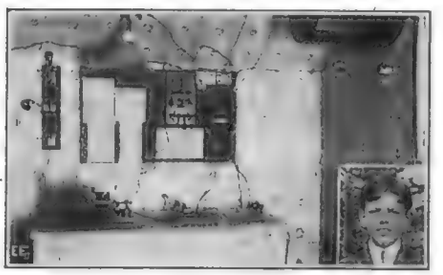
I will send you some illustrations of my wireless telephone and telegraph experimental sets in the near future.

EDWIN JACOBSEN.

Seattle, Wash.

RADIO SET OF B. W. DAVIS.

The accompanying photograph is of my wireless station. I will give a brief description of the station. Sending set: Thordarson 1 kw. transformer, home-made oscillation transformer, straight spark gap and 5-gallon bottle condenser, key and switches. Receiving set: 1,500-meter loose coupler with hard rubber contact and switch point bases, hard rubber base galena detector and buzzer test, Electro Importing Co.'s loading coil and fixed condenser, Brandes' 2,000-ohm 'phones. I have 1 T. P. D. T. aerial switch and 1 S. P. D. T. lightning switch, also 1 D. P. S. T. switch for power circuit control. I also have radio maps of this city, Great Lakes, United States and the world. The aerial is 35 feet high, 65 feet long, with a one-wire 15-foot lead-in. It is composed of four strands of No. 14 Antenium wire, spaced 3 feet apart on 9-foot bamboo spreaders.



Benton W. Davis and His Wireless Outfit.

The local amateurs come in loud, and I also copy Arlington (NAA), Buffalo (WBL), Detroit (WDR), Ashtabula (WSA), Cleveland (WCX), Sarnis (VBE) and Point Burwell (VBF), Canada, besides many boat stations on the Great Lakes.

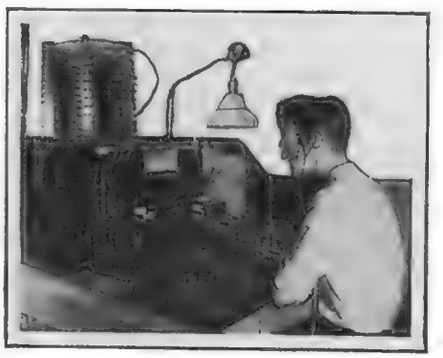
I have a Government operator's and station license, and my official call is 8QZ. I think your magazine is now the best of its kind in the field.

BENTON W. DAVIS.

Cleveland, Ohio.

RADIO STATION OF THOMAS R. HICKS.

I would like very much to see the accompanying picture of my station in *The Electrical Experimenter* radio station contest.



Thomas R. Hicks Gets All the Long Distance Stations.

My aerial is 70 feet high and 70 feet long and is composed of four cables, each consisting of seven strands of No. 22 B. & S. gauge copper wire. The ground is a No. 4 copper wire 40 feet long.

My receiving set contains a type A.A. Crystaloi detector, an inductive tuner, a 35-plate variable condenser, a home-made condenser and one set of Brandes' transatlantic 'phones. My sending outfit is composed of a 1-inch E. I. Co. Bulldog spark coil, E. I. Co. spark gap, aerial switch and electrolytic interrupter, a Brandes' heavy service key, a home-made helix and a high-tension condenser.

I get very good results with this set and can receive N.A.A., W.C.C. and N.A.R., besides all the amateur stations around West Chester.

THOMAS R. HICKS.

West Chester, Pa.

RADIO SET OF L. H. BUEHL.

The accompanying photgraph is of a wireless set I made in camp. I constructed it with a pair of pliers, a pair of scissors and a saw. The two-slide tuning coil was a rolling pin on which was wound bare copper wire with string as the insulating material. This was then shellacked. The end pieces and the base were made out of a soap box and the slider was made from a barrel hoop straightened out. The slider was a block of wood and a piece of tin; the condenser was also made of tin, with air as a dielectric, and last of all the detector was made from a safety pin and some mineral. I brought the 'phones, binding posts and minerals with me. The shellac was obtained at a near-by farm-house.

Louis H. Buehl Owns an Efficient Portable Radio Set.

LOUIS H. BUEHL.

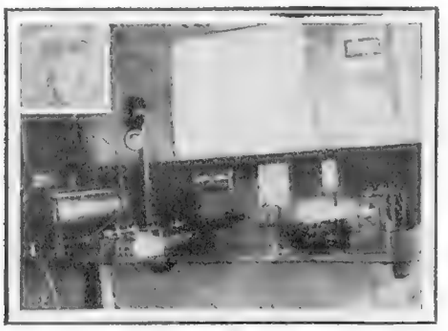
Philadelphia, Pa.

Electricity is man's most willing servant. It does all his tasks gladly, but, like a snake, will strike back when least expected.

EXPERIMENTAL STATION OF DAVE BORDWIN.

I present herewith photograph of my wireless station and myself, which I would like to see published in the monthly prize contest of your dandy magazine.

My aerial is 64 feet long, 38 feet high and is composed of four strands of No. 14 copper wire spaced 2 feet apart. The lead-in is of No. 4 wire run to a large 600-volt,



Compact and Serviceable Radio Station of Dave Bordwin.

100-ampere lighting switch. From there a No. 4 wire is run from the switch to a pipe driven 7 feet into the ground. The receiving set contains a large double-slide tuning coil, loading coil (next to tuner), fixed condenser and galena detector; these are all my own make. I also have one 1,000-ohm Brandes' receiver and an Electro leather-covered headband, which I like best, for it fits the head just right. A buzzer test is also used, which I can work from the table and also with my foot if desired. I shunt my detector while sending, so that I do not loose my "spot" on the galena and also do not then hear the noise in my receiver. The sending set has a 1-inch spark coil, Amco key, Electro spark gap and home-made glass-plate condenser. Both table and instruments are stained a light mahogany.

I hear Arlington very loud without using my loading coil. My receiving range is about 300 miles and sending range eight miles. I am very well satisfied with my station. I would be glad to hear from other amateurs. DAVE BORDWIN.

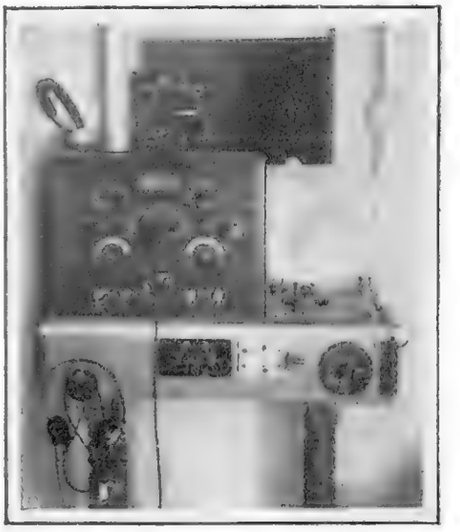
Paterson, N. J.

WIRELESS ON THE FARM.

Clement & Taylor, two Winthrop, Me., farmers, have a wireless telegraph installed on their farm. Mr. Clement, who was a telegraph operator before he was a farmer, has installed a receiving apparatus at their farm and they are thus able to get the standard time and the weather reports from Washington every day, learn the latest war news, and oftentimes catch messages sent out from boats at sea signaling in their location. He generally knows when the Boston boat gets in at night, and although the change from the Morse code to the Continental, used by the Government, bothered him a little at first, he is able to decipher most of the messages which his receiver is sensitive enough to take.

WIRELESS OUTFIT OF F. B. MEEKER.

Below is a picture of my wireless station, and the following comprises the apparatus which I am using: One type R. L. C. 3 special Mignon receiving cabinet, one E. I. Co. vario-selective cabinet set, one Perikon, one Gribe and one Electro detector; also one E. I. Co. loading coil, fixed variable and fixed condenser, a set of their 3,000-ohm 'phones and one set Navy type 2,000-ohm receivers. I have two aerials; the larger



F. B. Meeker's Modern Wireless Outfit.

one is 110 feet long and consists of two wires on 3-foot spreaders, and the smaller one is 50 feet long, with four wires on 6-foot spreaders. Both of these are supported on masts located on the roof.

New York City. F. B. MEEKER.

Amateur News

Radio Prizes Offered by Troy Amateurs.

The Amateur Marconi Radio Association, of Troy, N. Y., and vicinity, is planning an active fall and winter season. Extensive experiments with portable wireless receiving sets will be conducted and prizes will be awarded to members transmitting messages the greatest distance. The association has a large membership and practically everyone of its members has his own wireless plant. The association, however, is desirous of increasing its membership so its work can be carried on along broader lines, and the president, W. W. King, would like to hear from amateur wireless operators not already members. The association has its meetings in the North Troy Young Men's Christion Association building, and each of the meetings is addressed by experts. Malcolm Williams, of 1627 Seventh Ave., Troy, has been elected secretary in place of Harold Connor, who recently resigned. Communications relative to membership should be addressed to Secretary Williams.

Radio Club of Hartford News.

About 50 members of the Radio Club of Hartford, Conn., gathered at the State armory recently for the purpose of inspecting the new wireless apparatus received by the National Guard. After the apparatus had been thoroughly looked over in the squad drill room, it was carried out to the armory lawn and set up there and the members of the club picked up many messages from the sky. At the conclusion of this test the members gathered in the company room of the signal company and listened to Captain George E. Cole, who told them the nature of the service in the National Guard, its good points and bad. As a result it is expected that a signal section of 20 members of the club, all more or less acquainted with the art of wireless signaling, will soon be enlisted and put in service.

Western Students to Have Radio Club.

The students of Western High School, at Bay City, Mich., are working on a wireless station which will be in receiving range of all high power stations on the coast. The aerial was constructed and put up last June and the students are now working on a condenser, oscillation transformer and rotary spark-gap. Mr. Crawford, one of the instructors, is in charge of the work.

The object of the station is not to make wireless telegraphy a part of the course of study, but to organize a club of enthusiasts. One meeting has been held by the students who expect to join the club, and it is expected that in the course of one or two more meetings the organization will be perfected.

Wireless for Boy Scouts.

At a meeting of the Boy Scouts of Orange, Texas, of which Stanley Barnes is the scoutmaster, a movement was started for the establishment of a wireless telegraph station at that place. The boys will seek the assistance of citizens. They believe that it will come in for good service in the event that the telegraph and telephone wires should cease to work, as they did during a recent storm.

Radio Apparatus for Hartford, Conn., Y. M C. A.

The educational department of the Y. M. C. A., of Hartford, Conn., has bought a complete wireless telegraph receiving set, and is having erected on the top of its new seven-story building a large aerial for the use of a class of boys. This class will have for its object both instruction in the use of the wireless apparatus and its construction, and also the principles of electricity. The class will be taught by Clarence Tuska, who is already well-known in wireless circles as the secretary of the Radio Relay League, which has stretched across the continent within the last few years. He is also well-known in Hartford because of his ability in the use and construction of wireless apparatus. Without doubt this class will prove to be the most popular of the new boys' courses which the Hillyer Institute is putting in its curriculum this year.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

RADIO LEAGUE OF AMERICA.

(*Continued from page* 491.)

ciated by every radio amateur in the United States:

NEW YORK, November 27, 1915.

Editor of ELECTRICAL EXPERIMENTER, 233 Fulton Street, City:

DEAR SIR: Thank you for your favor of November 22.

I fully realize that the Radio League of America may accomplish much good in the development of the art, particularly in bringing influence to bear on Congress in the interests of new legislation regarding regulation of wave lengths and interference.

The Institute of Radio Engineers is now seriously considering a propaganda for bringing about new legislation, which will probably be in the form of permitting more or less individual freedom of wave length within certain restricted zones. For example, the amateur should have individual freedom within a certain zone of short wave length, commercial vessels should have two zones, one for smaller vessels and one for the larger ones, equipped with high power apparatus. The Government should have two or three zones, and the commercial shore stations also should have one or two zones of wave lengths allotted to them.

If such a proposition as this is carefully looked into and energetically brought to the attention of Congress, I believe much good will result.

I have no doubt that most of the members of the Radio League will enthusiastically champion such an effort, if it is properly put before them.

I would suggest that when the time comes you would consult with the authorities in the Institute of Radio Engineers, so that all may cooperate and work together towards a common end.

Wishing the Radio League of America every success, I am, Yours very truly,

LEE DE FOREST.

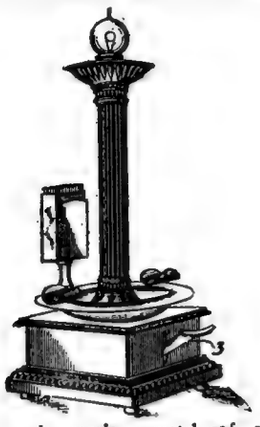
Do not fail to read the big announcement of the *Radio League of America* in the December issue.

LATEST PATENTS

Electric Waiter-Signal.

(No. 1,149,933; issued to Antoine Martzolf.)

A novel device, which embodies a miniature electric lamp and pedestal

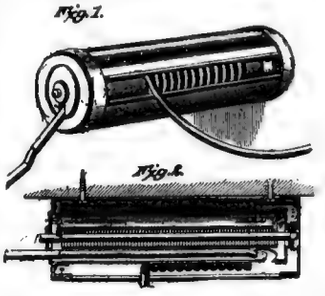


which also carries a match safe and ash tray. One purpose of this device is stated to be that of lighting up the match holder and the second distinct purpose called for in the use of this arrangement is in restaurants, so that by pressing the switch lever 3, on the side of the pedestal base, the patron can silently engage the attention of the waiter without annoying other guests. A miniature battery lamp is used in this device, together with a regular flashlight battery of small size contained in the base of the pedestal.

Take-Up for Flexible Conductors.

(No. 1,153,829; issued to Ernest F. Rueckert.)

A useful device in the form of a

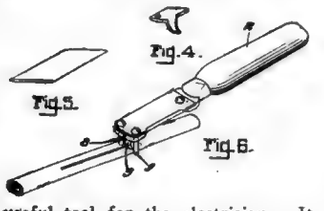


spring actuated drum and shield over the outside of same for automatically taking up or letting out flexible cord such as used for electric lamps or heating devices, etc. The drum is arranged so that by a slight pressure it will be released and as much cord as required may then be drawn out from the slot in the outer shield.

Tool for Stripping Wire Insulation.

(No. 1,153, 286; issued to Henry D. Cahill.)

This device for stripping insulation from electric wires should be a very

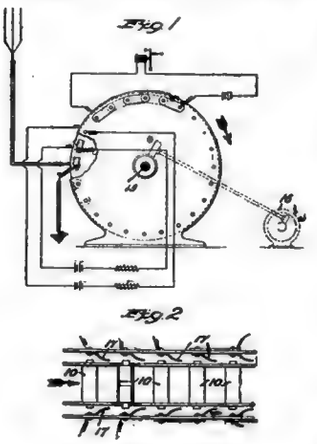


useful tool for the electrician. It embodies the use of a stripping knife 8 and two guide pins 8 and 9. These are suitably supported on the handle 2 and when the device is drawn along the insulated conductor, such as duplex cable for instance, the braid covering is easily slit open. As observed this tool is much more accurate and satisfactory than a common penknife for the purpose, unless the latter is wielded by a skilled mechanic.

Multiple Detector Scheme for Radio Receptors.

(No. 1,155,653; issued to Edwin R. Gill.)

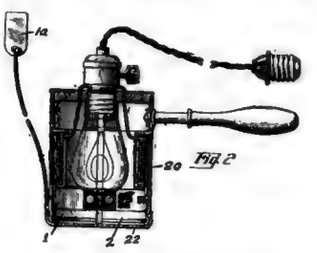
A scheme utilizing the principle of successively switching into circuit, a number of coherers in the radio receiving circuit proper, and which may be successively hooked up in a common circuit in series or in parallel with respect to themselves. A motor or other device 16, is utilized to constantly rotate a wheel and axle



13, and the coherers are mounted on the periphery of the wheel, as depicted at 10. Spring contact 17 closes the circuits of the various coherers as perceived. Several advantages are claimed for this arrangement including the operation of mechanical devices by means of a relay. Also steady operation is said to be obtainable owing to the constantly changing number of detectors, which are de-cohered in a separate electric circuit and revolved back into the radio receiving circuit proper again, etc. Several features which cannot be covered here for want of space are incorporated in this patent and it will pay those interested to procure a copy of same.

Thermo-Electric Treatment Apparatus.

(No. 1,154,144; issued to Alma M. Wagoner, administratrix of the Estate of James B. Wagoner, deceased.)

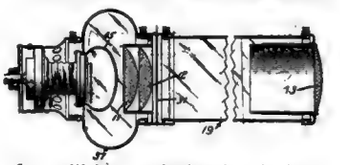


The patentee of this device for electro-therapeutics has provided same with a pilot lamp as perceived, to indicate whenever current passes through the instrument. At the lower end there is stretched a fabric diaphragm 22 to be placed in contact with the patient's body. The electrode 10 is applied on another portion of the body. Surrounding the lamp are two semi-cylindrical plates 1 and 2. At the center there is wound a primary and secondary coil. When the apparatus is in use an induced current from the A. C. supply is produced in the secondary coil 20 and by means of a condenser action a mild current is thus caused to pass through the patient's body, from the electrode 10, through the nerves and muscles, to the semi-cylindrical plates 1 and 2.

Electric Advertising and Illuminating Lamp.

(No. 1,153,445; issued to Joseph T. Roffy.)

This idea covers an arrangement

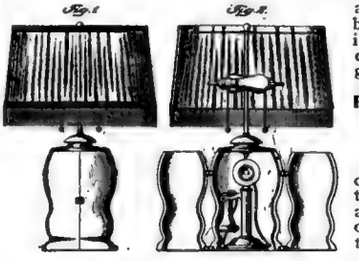


for utilizing a single electric lamp 45, which projects a beam of light through the lenses 11 and 12 and advertising stencil at 31. This stencil has its image thus projected through the tube 19, and lens 13 onto the sidewalk in front the store, etc. Simultaneously the lamp 45 is here used by the inventor to provide general illumination through the special glass shade 37.

Combined Lamp and Telephone Cover.

(No. 1,153,507; issued to James McIntosh.)

This patent covers a special form of electric or other lamp as observed the pedestal of which is so formed as to readily contain an ordinary desk type telephone within it. This apparatus is accessible by simply

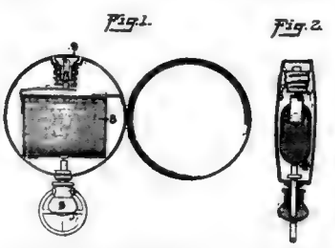


opening the double doors forming a part of the lamp pedestal.

A Watch Style Flashlight.

(No. 1,155,249; issued to Harry M. Koretzky.)

A much desired style of electric flashlight resembling the ordinary watch in size and appearance has been here developed. The drawing shows clearly how the inventor arranges the battery B, and also how the push button S is incorporated in the special stem 5. The tungsten lamp appears at 9 and the patent also

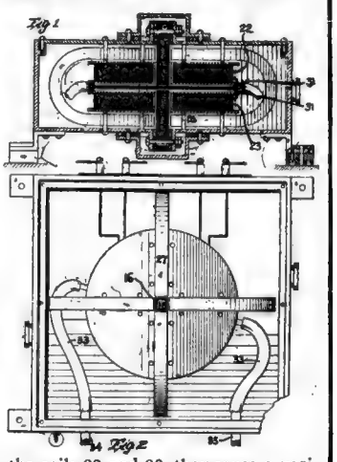


covers the arrangement of this lamp crosswise in the case.

Sound Intensifier and Reproducer.

(No. 1,153,431; issued to Clinton Horace Hulbert.)

A distinct and novel form of sound amplifier and reproducer adaptable to telephonic or radio purposes is here shown. It is provided with four permanent steel magnets, placed 90° apart, in a special sound insulated box, as drawing shows. Between the magnet poles are mounted two electro-magnet coils 22 and 23. A laminated iron core appears at 16. When a telephonic or other current passes through the coils, it causes a compound polarization action in the two magnetic diaphragms 31 and 32. These diaphragms are placed close together and form a gas-tight chamber between them, which chamber is joined to the rubber tube 33 and nozzles 34 and 35. Compressed air or gas may be used in the chamber formed between the two diaphragms and when these are pulled apart, by the electromagnetic action due to currents in



the coils 22 and 23, they cause a variation in the gas pressure, which may be manifested at a gas tip, thus making possible the recording of a voice on a moving strip of film, photographically.

Flashlight Attachment for Pencils and Pens.

(No. 1,148,661; issued to Hunter Dennis.)

A unique flashlight attachment including miniature battery B, is contained in an insulated cap 25, attachable to the end of any ordinary pen or pencil. Connections are arranged to be carried in the device, down to

the miniature electric bulb 33, provided with a reflector 34. A timely invention which should prove of value to reporters, professional men and others, when properly commercialized.

A Cigar Style Flashlight.

(No. 1,153,420; issued to Alexander Brody.)

The inventor of this flashlight proposes to make same in the form of a cigar and also to finish the outside of it to resemble such. The usual battery and flashlight bulb are contained within the shell and instead of using an ordinary switch or push

button to light the lamp, he makes use of a split push 17, intended to be gripped between the teeth and in this way closing the circuit through the device. This leaves both hands free. Presumably the whole affair has been gotten up more as a novelty than anything else.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

O. WHATAHED, CITY OF HADES

No. .01 ($.9\sqrt{6^n}$) **LAZY MAN'S DELIGHT** **Patent Applied for at Bedtime Regularly.**

To All Gents and Others,
Whoever It Concerns:

May it be known that I, O. Whatahed, of the City of Hades, State of Indolence, have at last, after many nightmares, rescued the poor married man from the bugaboo of laboring deep in the cellar while "She" rests comfortably in the arms of Morpheus. No longer does he have to get up at 5 o'clock in the morning to woo the furnace and "go six rounds" with the ash can, besides wasting matches and temper trying to get the furnace started. Now all he has to do to keep the house, feet and heart warm is to 'phone to the coal dealer and make out the check. The rest of the hard work around the household is taken care of by my apparatus, which has taken the lifetime of my father, his father and myself to perfect.

A can of opium and a glance at the specifications attached will clear away all fog as to how this wonderful apparatus operates. It may be attached to any common furnace by merely removing the ashes and coal that normally lay about and putting the apparatus in place. The operation of this device will be understood by all mechanical and electrical husbands skilled in the art of coalfurnacing.

The operation of this apparatus is entirely automatic. The solenoids A and C operate, when the pressure drops below a certain point, to feed more coal to the furnace O. The surplus steam drives a triple expansion cross-compounded engine operating the generator, which in turn charges the storage batteries I. These storage batteries are used for lighting the house and for sundry other purposes, such as dispelling the fog in the fire room and operating the various solenoids. The feed pump E is controlled by solenoid B, which is regulated from the well by the water level indicator and keeps the proper amount of water in the boiler and thus prevents explosions and also any disturbance of the owner's dreams. The solenoid D automatically turns on the engine when the charge in the batteries drops below a certain predetermined but unknown point.

By means of the switchboard mounted in the kitchen it is possible to keep tabs on the apparatus and control the "juice," which is so freely generated by this magnificent plant. The switchboard also has mounted on it the usual steam pressure indicating apparatus and a whistle.

This whistle may be put to several uses, among which may be noted that it will play *"I Didn't Raise My Boy to Be a Stoker,"* to call the family to breakfast and to hail passing mortals who are rolling heavily on account of undue cargo and who consist mostly of the flotsam and jetsam cast aside by the sea of Fate.

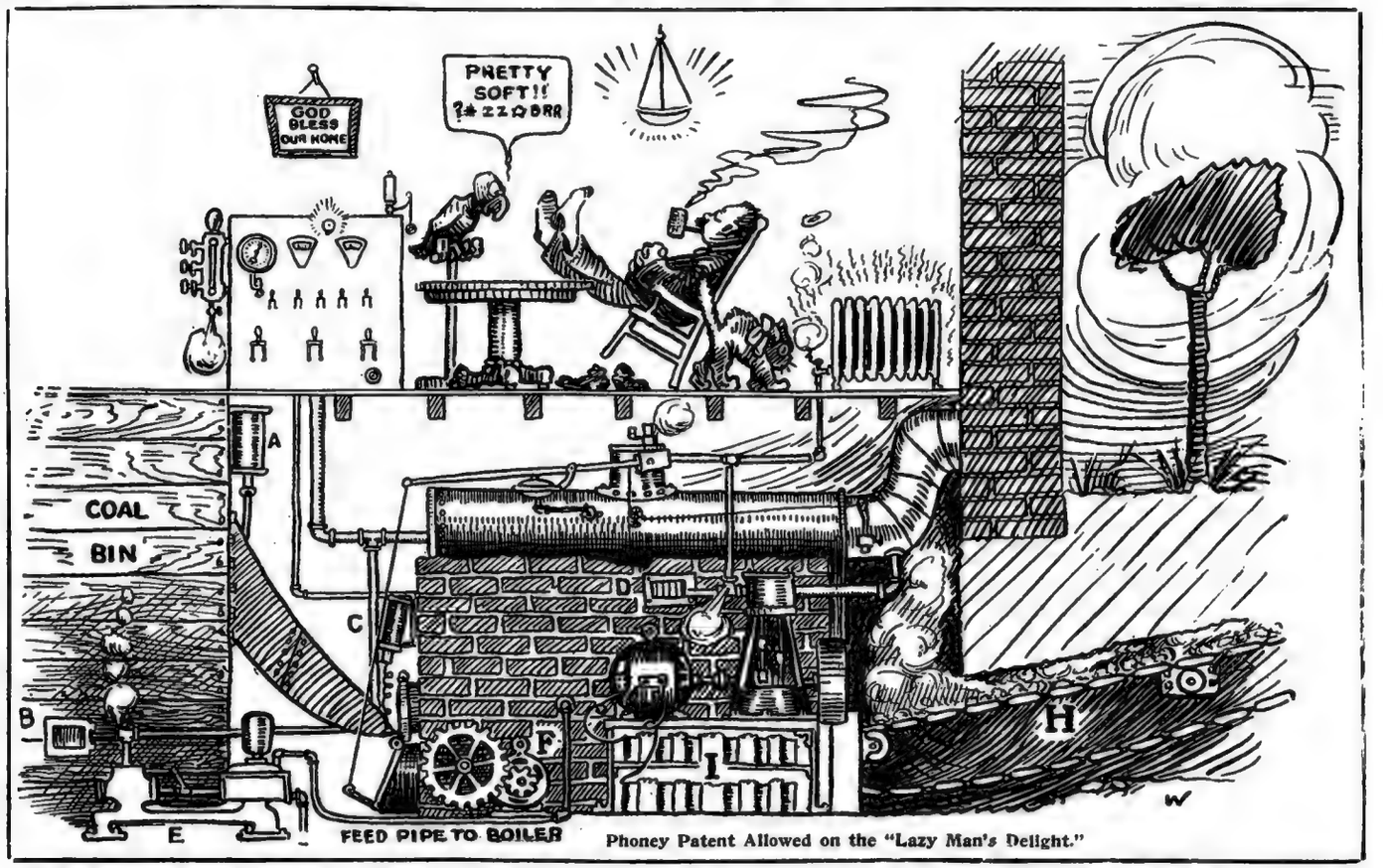
The main defect with furnaces and such allied appliances is that they provide no means for the removal of ashes, but I get away from this by having a traveling grate driven by the motor F and the conveyor H. These take care of the ashes from the furnace and remove them to regions unknown and unexplored by others than the employes of the Ash Removing Contractional Corporation.

At present the only thing that is lost with this apparatus is the "smoke" and the sound of the steam whistle; however, plans are being made to utilize both. Thus tobacco will be used as a fuel, and by running a pipe into the chimney I will be able to compress the smoke and supply it to the consumers in large quantities and thus put the ever-grasping Tobacco Trust out of business. This latter detail is of so much importance that I have applied for a separate Phoney Patent on same. Arrangements have also been made to sell the whistle's sound to the Phonograph Trust.

In testimony thereof, for or against, etc., ad infinitum, I hereto attach after heretofore disattaching one certain and specified seal (live, stuffed or coat) this night of horrors in the City of Hades.

Witnesses:
G. Wilikens,
O. Piffle,
I. Gotbit.

O. WHATAHED,
By his attorney,
Alvin L. Akers.



Phoney Patent Allowed on the "Lazy Man's Delight."

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. **Only three questions can be submitted to be answered.**
2. **Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.**
3. **Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.**

Radio Engineers.

(395.) Frederick B. Stock desires to know the training necessary to become a radio engineer.

A. To become a first-class radio engineer, worthy of the name, it is necessary to have a complete knowledge of mathematics and more or less information on general electrical subjects. The best thing to do is to take a course in electrical engineering at some college or university, and after graduating from same to take post-graduate work of about two years in some school that teaches radio-telegraphy.

Radio Licenses.

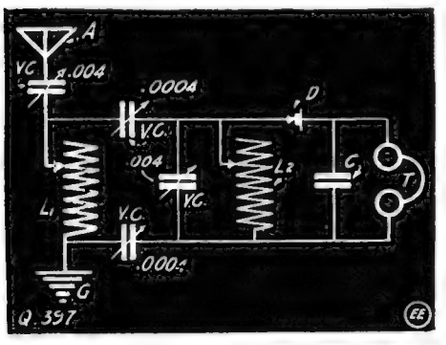
(396.) George E. Watt, Brooklyn, N. Y., requires information on the necessity of obtaining a license for wireless apparatus.

A. In answering this we can do no more than quote the law on this point, which states that no person, company or corporation shall use apparatus "for the transmission of radiograms or signals, the effect of which extends beyond the jurisdiction of the State or Territory in which the same are made, or where interference would be caused thereby, with the receipt of messages or signals from beyond the jurisdiction of the said State or Territory, except under and in accordance with a license, revocable for cause, in that behalf granted by the Secretary of Commerce and Labor upon application therefor." No license is required for receiving wireless messages.

Details of Dr. Cohen's New Set.

(397A.) T. C. Potts, Pittsburgh, Pa., writes us asking: 1. The size and amount of the wire used in the inductances in Dr. L. Cohen's receiving set. 2. Will this set be superior to a set composed of the standard instruments, loose coupler, etc.?

A. 1. The accompanying hook-up gives the size of the condensers used with the Cohen apparatus. The inductance coils, L_1 and L_2, for this set may be made on a tube 18 inches long by 6 inches in diameter, wound with No. 28 S. C. C. wire. This size will be sufficient for all-around amateur use, and you will be able to tune to wave



Dr. Cohen's Radio Receiving Hook-Up.

lengths in the neighborhood of 4,000 meters.

A. 2. This apparatus is vastly superior to the loose coupled tuners, as it takes up less space, is easier to adjust, and is, besides, more efficient and selective.

Step-down Transformer.

(397-B.) Joseph G. Reed, New Lambton, N. S. W., Australia, desires to know the dimensions of a step-down transformer for changing 240-volt, 50-cycle alternating current to 110-volt alternating current having a capacity of 1 K.W.

A. This transformer should be wound on a rectangular core having a cross-section of four sq. in. and forming a square 12 in. wide by 14 in. long. The primary should consist of 720 turns of No. 12 D. C. C. wire insulated from the core by four or five layers of Empire cloth. The secondary contains 330 turns of No. 10 D. C. C. wire and is also insulated from the core. This transformer can be connected direct to the 240-volt supply and will be self-regulating, have an over-all efficiency of about 80 per cent. if high-grade transformer iron is used in constructing the core.

Harnessing Gravitation.

(398.) George Abkemeier, Washington, Mo., writes us about an original scheme intended for use in driving a small 80-watt generator. He intends to use a drum on which a rope is wound, and a heavy weight is attached to the end of the rope. He intends to gear this arrangement up with a set of six pulleys, with a ratio of approximately 50,000 to 1. This is to be used to drive the machine at 2,000 r. p. m. and to run for four hours with the weight to drop only 60 feet. He wishes to know if this scheme is practical, and the weight to be used?

A. We would like to say that this scheme may be feasible, but the great loss entailed in so many gears reduces the efficiency of the apparatus. We have calculated the weight necessary, taking for granted that the rope is to be wound on a drum one foot in diameter and the efficiency of the arrangement 80 per cent.; when, as a matter of fact, it will hardly exceed 40 or 50 per cent. With the above arrangement it will require a weight of 18,000 pounds to drop 60 feet for four hours' run, or 15 feet an hour, to drive the dynamo up to full capacity. The only way to offset this tremendous amount of weight is to use a smaller weight arranged to drop through a greater distance.

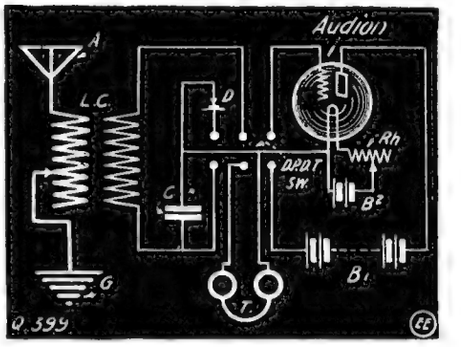
Hook-up for Detector and Audion.

(399.) James L. Autry, Jr., Houston, Tex., writes us asking: 1. How to connect an audion with a crystal detector so that either can be put into the circuit by means of a switch? 2. How to connect his 2,000 and 2,800 ohm head sets so they will give the loudest signals under all conditions? 3. How to use a Knapp type battery motor on a bell-ringing transformer?

A. 1. We give herewith illustration which will enable you to quickly switch from mineral detector to audion for receiving wireless messages. One D. P. D. T. switch is necessary for this purpose.

A. 2. The 'phones you mention are nearly of the same resistance, and you may connect them in series in accordance with the usual practice, and the results will be very satisfactory.

A. 3. You may operate the small battery



Audion or Mineral Detector Controlled by D. P. D. T. Switch.

motor from alternating current by two methods. One is to short-circuit the commutator by wrapping a few turns of bare copper wire around it and removing the brushes. The field is connected direct to the current supply, and the motor will operate as an induction motor. Another method of accomplishing this result is mentioned in the December issue of *The Electrical Experimenter* on page 422.

X-Ray Screens.

(400.) Gerry Davis, Union City, Pa., wishes to know what chemicals are employed in making a fluoroscope screen for X-ray work?

A. Several chemical preparations are used for this purpose, particularly sulphide of zinc, tungstate of calcium, platino-barium-cyanide. The latter is the one most used, giving excellent results, but is rather expensive.

The Sayville Station.

(401.) George Huss, Lakewood, N. J., desires to know: 1. The type of radio transmitter used at Sayville, L. I., and wave length of this station. 2. Whether Sayville has any regular schedule for transmission; and, if so, at what time? 3. The power of several other stations.

A. 1. The transmitter used at the Sayville station at the present time is of the well-known frequency changing type described several times in the past in *The Electrical Experimenter* and gives a high frequency current without the use of spark gaps. The wave length used by Sayville is, to the best of our knowledge, about 6,000 meters.

A. 2. Sayville starts to send "press" to ships at sea at about 9 o'clock in the evening and repeats the messages. The length of time the operator sends depends on the amount of business to be transacted. The station works at frequent periods during the day, depending, of course, upon the business on hand.

A. 3. We are not aware of the power used in the various stations mentioned in

(*Continued on page 506.*)

THE ELECTRO-SET CO. PRESENTS THIS PAGE FOR EXPERIMENTERS

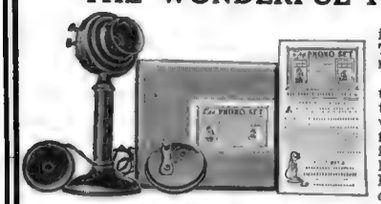
Showing a few of the Extraordinary Values in their Catalogue and Listing Several Bargains in Used Parts and Apparatus that no Experimenter can afford to miss

OUR FAMOUS 1-6 K. W. TRANSFORMER

Thousands of amateurs will welcome the advent of this instrument who either did not require ¼ K.W. power or who did not care to spend the money for it. The transformer will send messages for twenty miles—not a wild figure, but an actual fact—if a good aerial is used. **Under extraordinary circumstances it will send one hundred miles.** No trouble with vibrators and adjustments, reactances or resistances. **Just connect the primary terminals to 110 volt, 60 cycle A. C. mains and press key.** Best silicon transformer iron is used in its construction. The primary is wound with cotton covered, enameled wire, costing more but safer than single cotton. The secondary is built in sections each wrapped in empire cloth. Mica insulation is used where necessary. It will throw a heavy crashing spark that, with proper condenser, will fill a gap with a ball of white flame ¼ inch in diameter. This comparatively small but powerful spark will send **six times as far as a 1 inch spark coil.**

No. 1000 1-6 K.W. Closed Core Transformer, without case, shipping weight 10 lbs. **$6.95**

THE WONDERFUL PHONO-SET $1.00

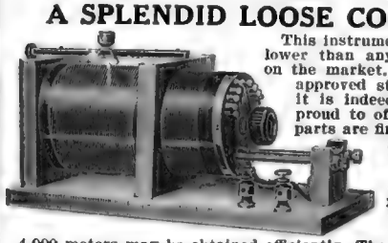


A handsome, perfect working miniature desk telephone, 7½ in. high. Talks for hundreds of feet (¼ mile) between any two points.

Outfit consists of regulation pattern desk 'phone with carbon grain transmitter, and a handsome little watch case telephone receiver with flexible cord for connections. A polished wood base switch is included FREE with each outfit. Handsomely finished in black enamel. Works on one 15-cent dry battery. Two outfits are required to talk both ways. One outfit talks one way. Full instructions included. A 10-year-old boy can connect and operate it. The first time an Electric Telephone ever was made at the price; only tremendous production makes it possible.

Price, postpaid **$1.00**

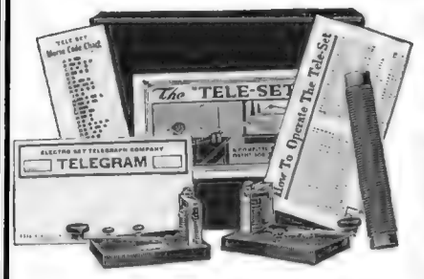
A SPLENDID LOOSE COUPLER AT $6.85



This instrument is priced at from 20 to 50% lower than any other instrument equaling it on the market. Made throughout in the most approved style and of the best materials, it is indeed an instrument which we are proud to offer to our customers. The wood parts are finished in polished mahogany and are carefully screwed together. They will not fall apart or warp, as do the instruments of some manufacturers. Our "Senior" Loose Coupler will respond to wave lengths up to 1,800 meters, and with a loading coil 4,000 meters may be obtained efficiently. The secondary has 10 contact points varied by a large, rotary, rubber composition knob. The primary is varied by a slider. Size 5x6x12 inches. Shipping weight 10 pounds.

No. 1696 "Senior" Loose Coupler **$6.85**

A REAL TELEGRAPH OUTFIT $1.00



A remarkable little telegraph outfit that telegraphs TWO WAYS for a distance of one-quarter mile and more if sufficient wire and batteries are used.

A FASCINATING TOY
A Practical TELEGRAPH

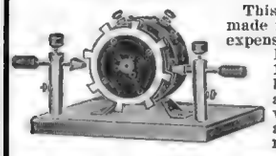
The outfit includes instruments for two stations with keys and sounders, Morse Code Chart, Miniature Telegraph Blanks, full instructions and enough wire to start experimenting. Works with any dry cell or doorbell battery.

ANY ONE CAN LEARN TELEGRAPHY
Boys Can Have Great Fun

Price, complete as above; neatly packed in an attractive box..... **$1.00**

Do not confuse this outfit with those sold at a higher price for only ONE station. This outfit has TWO stations.

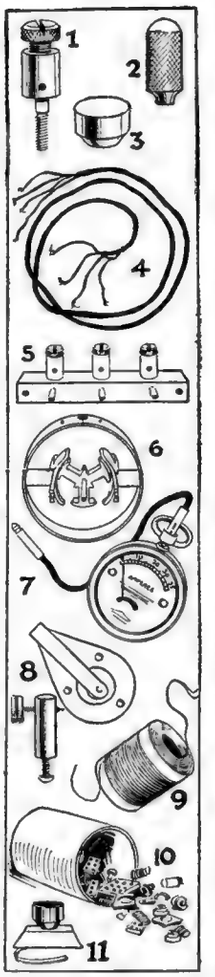
THIS FINE LITTLE ROTARY GAP $5.50



This Rotary Spark Gap is without an equal. It is made in every particular as well as any of the more expensive gaps, the only difference being the size. It operates in series with a 16 C. P. lamp on 110 volt alternating or direct current or from batteries. The Rotary Electrode is of cast aluminum alloy and is perfectly accurate. The wheel is mounted with genuine hard rubber on a heavy brass bushing which fastens to the motor shaft. The stationary electrodes are mounted on brass posts and are fully adjustable. Will stand ¼ K. W.

No. 476 Type "A" Rotary Gap, shipping weight 4 lbs..... **$5.50**
No. 477 Type "A" Rotary Gap, wound to operate on 3 dry cells..... **5.00**
No. 478 Three Inch Rotary Disc Only, mounted on hard rubber, with brass bushing, ⅛ in. hole; shipping weight 4 oz..... **1.50**

THESE PRICES WILL SELL THESE GOODS



Here are extraordinary bargains for experimenters. We want to dispose of them quickly. The prices are ridiculously low. Get out a memorandum and decide what you can use. Order **now.** Many were disappointed last month. The prices hold good only as long as the specials last.

No. 1—Binding Posts, ¾ in. high, handsomely nickeled, patented design. Worth 6c. ea. Special, ea. 2½c.; per doz., **25c.** Postage per doz., 5c.

No. 2—Hard Rubber Knobs, ½ in. in diam., threaded for 6-32 screw. Worth 3c. each. Have been used. Special, per doz. **10c.** Postage extra per doz., 3c.

No. 3—Hard Rubber Handles, ⅞ in. long, threaded. Have been used. Worth 4c. each. Handy in making apparatus. Special, per doz. **15c.** Postage per doz., 4c.

No. 4—Triple Receiver Cords, new; 4 feet long; contain 3 separate cords. No tips. Worth 50c. each. Special, postpaid **20c.**

No. 5—Connecting Blocks, genuine hard rubber with 3 handsome, nickeled binding posts. Useful for many purposes. Worth 25c. each. Special, each **9c.** Postage each, 3c.

No. 6—Motor Parts, consisting of 3-pole laminated armature and frame with pole pieces. Make your own motor. Parts worth 40c. Special, per set **10c.** Extra postage, 5c.

No. 7—Ammeter, 0 to 35 amperes; new and in perfect condition. Regular $1.25 value. Very special; while they last, **75c.** Postage extra, 5c.

No. 8—Spark Coil Secondaries, ½ in., spark length. Two assembled on a primary coil will give 1 in. Each one tested and in perfect condition. **Make your own spark coil.** A wonderful bargain. Worth 90c. each. Very special, each **30c.** Postage extra, 6c.

No. 9—Spark Coil Vibrators, for small coils only. New, perfect condition. Very special, complete **25c.** Postage extra, 3c.

No. 10—Experimenters' Handy Box, a splendid bargain; useful for all experimenters. Consists of a box containing between 40 and 60 odds and ends of electrical parts, coils, nuts, knobs, posts, rings, washers, etc. Useful in constructing apparatus of all kinds. We've sold hundreds of them. Every experimenter needs this box. An unusual and extraordinary offer. Get yours **now.** While the parts last, per box, postpaid **20c.**

No. 11—Sliders, for ¼-in. square rod; in good condition. Each **9c.** Postage, 1c.

Electro-Set "Arlington-Tested" Crystals

When testing out a wireless receiving installation for the first time, you want to know that your mineral crystal is sensitive. Then, too, why buy minerals on a gamble? **Be sure of results—good results.** Buy our **"Arlington Tested"** Crystals. Every one is tested for Arlington time signals. Each crystal comes in a sealed Metal Box and is carefully tested before leaving our factory. **Only one crystal in 20 passes our examination.** Arlington Tested Crystals are the most sensitive you can procure. They are worth the price. Each one is individually examined and packed.

No. 301 Arlington Tested Galena, individually packed and tested; postpaid **$0.15**
No. 302 Arlington Tested Silicon, as above..... **.15**
No. 303 Arlington Tested Bornite-Zincite Couple..... **.40**

ELECTRO-SET MINERAL ASSORTMENT, 50c.

Here's something every experimenter will welcome. Five different minerals, each in a metal container (5 boxes) for wireless detectors—only **50 cents,** postpaid! Included in this offer are the following minerals: Silicon, Galena, Molybdenite, Ferron and Carborundum. **Free** with each set, a piece of phosphor bronze detector wire. One of the most interesting experimental fields is in wireless detector minerals. Send for an outfit to-day.

CATALOGUES

SEND 4c. TO-DAY FOR OUR BIG NEW CATALOGUE containing description of dozens of new wireless and experimental instruments, parts and raw materials. Prices are new—instruments are new—a catalogue every experimenter MUST HAVE.

WRITE TO-DAY—SPECIAL CATALOGUES

Send **6c.** in stamps for our SPECIAL ELECTRIC TRAIN CATALOGUE, illustrating scores of models. Send 4c. in stamps for our Electric Vibrator and Medical Coil Catalogue.

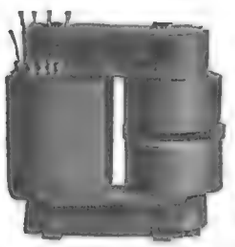
WE ARE AGENTS FOR MARCONI USED APPARATUS

Send **5c.** in stamps for new, interesting catalogue of used Marconi Wireless Instruments at ridiculously low prices. We are agents for this line and can ship promptly anything from a Type "D" Tuner to a Motor Generator.

The Electro-set Co. Dept. 210, 1874 E. 6th Street, Cleveland, Ohio

YOUR RANGE
DEPENDS ON YOUR
RECEIVERS

Holtzer-Cabot Radio Receivers
have honestly earned their reputation of being the
"Most Sensitive Receivers Made"
Other features are light weight, comfortable shape, durability, perfect finish. Send for Booklet 20 D2 for description.
THE HOLTZER-CABOT ELECTRIC CO.
BOSTON — CHICAGO


UNMOUNTED TRANSFORMER

You Can Get Results
with a small condenser and this transformer
It is a 1-2 K. W. size and is built on the same specifications as to material and workmanship, etc., as our big central station transformers.
Hundreds of stations are now using these transformers. This transformer gives you 13,200 volts.
Let us tell you how you can do part of the work yourself and get this transformer at a remarkably low cost.
THE PACKARD ELECTRIC CO.
555 Dana Avenue Warren, Ohio

ONE DOLLAR IN CASH GIVEN AWAY TO ALL who CUT OUT THIS ADVERTISEMENT and secure one of our $10 Four Volt 60 ampere (Christmas Tree Lighting) Storage Batteries for $4.45 at any of our three stores in New York. (Orders delivered or shipped by express $4.45 Net.) Electric Christmas Tree Lighting Outfits 95c. up. Lamps (all colors) 9c. up. Sockets 4c. up.
Broadway Electrical Novelty House, 111 Broadway 129 West 125th St. 324 Bowery
CHEAPEST ELECTRICAL NOVELTY HOUSE ON EARTH

QUESTION BOX.

(*Continued from page* 504.)

your third question, and therefore cannot be of service to you.

Transformer Efficiency and Condensers.

(402.) Forbes St. John, Noroton, Conn., desires to know: 1. Which type of transformer is used most in wireless work? 2. A formula for calculating the capacity of condenser for any transformer with a given secondary voltage, etc.?

A. 1. Closed core transformers are used almost exclusively at the present time, because they have the highest efficiency and the arcing at the gap is prevented by rotary or quenched gaps. Open core transformers were used extensively at one time, but they were required, due to the fact that the science had not progressed to the point of using the rotary gap, and as open core transformers have a very sharp peak in their secondary wave form, they gave better results with the straight gap formerly in vogue.

A. 2. We give you herewith formula for calculating the necessary condenser capacity for any transformer with a given secondary voltage, etc.:

$$C = \frac{K.W. \times 10^9}{f \times Sec.\ Volts}$$

In this formula, sec. volts is the secondary voltage of transformer; f is the frequency of the primary current of same; C is the capacity in micro-farads, and K.W. is the kilowatt rating of the transformer.

Poulsen Tikker and Aerial Construction.

(403.) C. M. Wickes, Bradford, Pa., asks for information on: 1. The Goldschmidt tone wheel and Poulsen tikker. 2. Which is the best way to connect an aerial, to leave the free ends of the strands open or to connect them together?

A. 1. You probably would do best to experiment with a "tikker" of the Poulsen type as described in the April (1915) issue of *The Electrical Experimenter* on page 228 thereof. When the Goldschmidt tone wheel is employed, no other detector is utilized, as you mention.

A. 2. It has come in practice to consider a wire grid aerial of the "L" or "T" type as simply a large capacity condenser and hence will be seen the idea involved in cross connecting the free ends of such aerials. In other words, they simply act as a large metallic spread which comprise a few wires spaced several feet apart, and it has been found that this gives practically the same effect as if the aerial were made of a broad metal sheet.

AN EXPLANATION.

We feel that an explanation is due to the readers of the *Electrical Experimenter* concerning the full page advertisement of the Electro-Set Co., Cleveland, O., which appeared in our December issue. Through a misunderstanding this full page ad was run in the November issue and, as stated in the original insertion, certain of the goods advertised were special lots at greatly reduced prices and orders could only be filled from quantity on hand. As additional quantities could not be furnished, we trust that those of our readers who have tried to order after certain stocks were exhausted will understand the circumstances. The Electro-Set Co. intends to act at all times in strictly good faith.

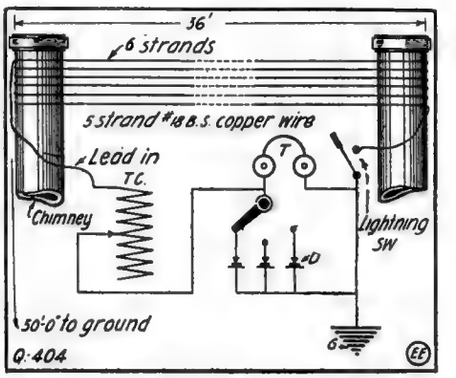
NEW SWEDISH RADIOPHONE.

Two Swedish army officers have invented a wireless telephone which is reported to have been used to talk from a moving train 740 miles, and it is to be used by aviators to connect them with their bases at all times while flying and to afford the commanders of warships means of direct communication.

Unique Aerial Construction.

(404.) C. Dyson, Roxbury, Mass., has sent us details of a peculiar aerial construction he has been using, and wishes to have our opinion on same.

A. We do not see how you can receive wireless signals at all, or at least it will be with very poor results, as your aerial apparently does not have any insulators on same. You should have all of the strands of your aerial insulated very carefully by



Novel Antenna Construction.

means of aerial insulators, or at least by some porcelain cleats. As the wireless currents are very weak indeed, it is extremely important that the aerial is very well insulated.

Transformer Design.

Francis De Kalb, Pine Bluffs, Mo., asks several questions regarding transformer construction for wireless purposes, particularly the action of the magnetic leakage type.

A. A transformer will work quite efficiently indeed in this manner, provided a variation in the output is controlled by adjusting the amount of primary inductance used.

The one-quarter kilowatt wireless transformer to be used under the requirements of the radio law, now in effect and specifying 200 meters wave length, should yield 12,000 to 20,000 volts preferably. This is necessary, owing to the very small condenser capacity, which is allowable in the oscillatory circuit, when 200 meters wave length is to be adhered to, and also in due consideration of the inductance which must be used in the circuit.

You may have as many taps in the primary winding of your transformer as desired; but, of course, it is not well to take taps from such a small number of turns that it will cause fuses to be blown, when the transformer is hooked up across the circuit.

Aerials for Air Craft.

(406.) Louis Schneck, New York City, desires information on the method employed by air craft for suspending their aerials when wireless messages are to be transmitted.

A. In aeroplane aerial construction a wire is generally run from the tips of the wings to the tail of the machine for an aerial, and for the ground a wire is dropped about 100 to 500 feet long from the bottom of the machine. This gives fairly good results.

In the larger types of the lighter-than-air machines, particularly the Zeppelins, a small aerial is erected above the gas bag, or a wire is suspended from each end of the machine, using one as an aerial and the other as a ground.

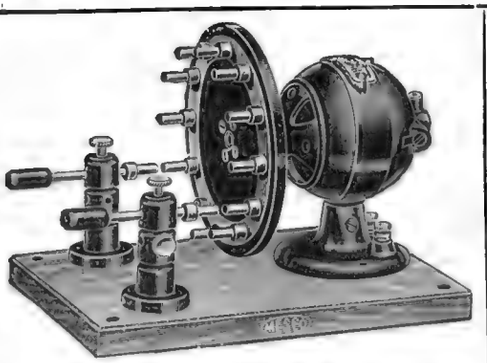
On Wireless Transmitters.

(407.) Orin F. Davis, Somerville, Mass., asks us: 1. What form of radio transmitter produces a hissing sound between the dots

(*Continued on page* 508.)

Be a Wireless Santa Claus to Your Boy

GIVE HIM WIRELESS APPARATUS GUARANTEED PERFECT OR MONEY REFUNDED



Mesco Rotary Spark Gap

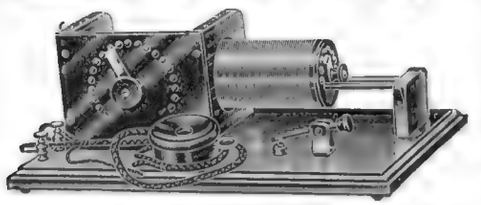
Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

Our Globe Motor is used. Will operate on 110 A. C. or D. C. circuits; speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

List No.		Price.
222	Mesco Rotary Spark Gap, 6 volt	$12.00
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit Only, with two Stationary Electrodes, 1 3/16 in. shaft	5.00

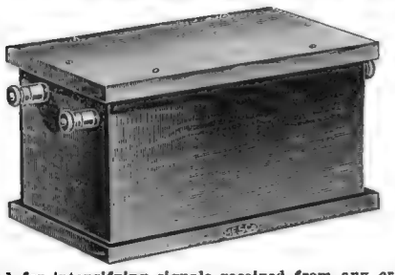
Manhattan Wireless Receiving Set



Consists of a loose coupler, fixed condenser detector, and an 80 ohm receiver with cord. Will tune up to 1,800 meter wave length on a 60-foot aerial. Can be tuned to waves over 4,000 meters with larger aerial and properly connected to loading inductance and variable condenser shunted across the secondary of the receiving transformer.

List No.		Price.
210	Manhattan Wireless Receiving Set	$10.00

Mesco Intensifying Transformer

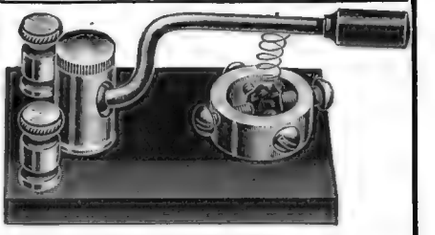


Used for intensifying signals received from any crystal detector by connecting an audion detector on the other side of the transformer winding. Used between two audion detectors, signals will be intensified 10 to 25 times.

As many as three of these transformers can be connected between audion detectors in cascade, forming an intensifier, making it possible to read signals not heard with any single known detector. Diagram of connections with full directions with each instrument.

List No.		Price.
224	Intensifying Transformer	$12.00

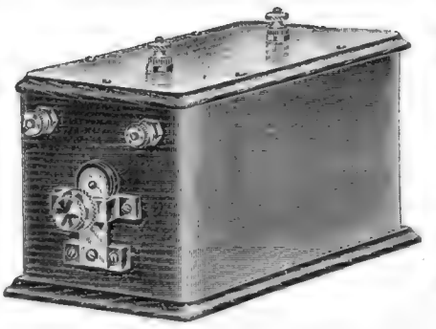
Mesco Universal Detector Stand



Has a heavy brass cup, with four binding screws; will hold crystals up to ¾ in. diameter. A hollow standard encloses a brass ball. Through an opening a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.

Hard rubber base 2¼x4¼x⅜ in. All metal parts nickel-plated. Remains permanently in adjustment under jars and vibrations of every description.

List No.		Price.
248	Mesco Universal Detector Stand	$3.00



Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case. Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum; spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	Spark Coil, 1 inch; can be operated on 6 Red Seal dry batteries	$5.40

Send 10c. for Copy of Our Wireless Manual No. 9

YOU GET YOUR MONEY BACK ON AN ORDER OF $1.00

It contains 120 pages and tells how to erect and maintain wireless telegraph stations. Shows a number of diagrams. Has the Morse and Continental Telegraph Codes. Illustrates the best instruments to use; tells what they are for and how to use them. Has many new diagrams and other valuable information not contained in any other book. Do not wait. Send your request now.

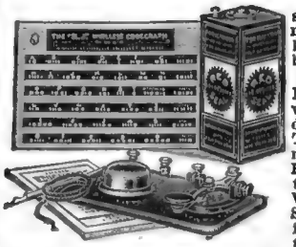
Get the Best 10c. Value You Will Ever Buy

SEND FOR OUR POCKET CATALOG, W 28

It contains 248 pages, 1,100 illustrations and costs you nothing.

IT MEANS MONEY SAVED TO YOU to have our Manual and our Catalog when you want to buy.

Mesco Codegraph



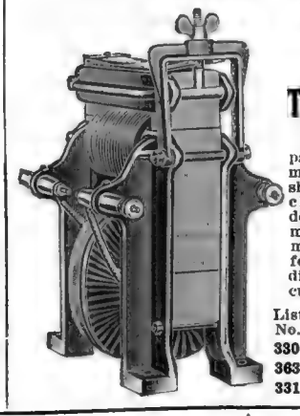
A dandy practice set for the beginner. Just the right kind for the apt boy.

The Codegraph Plate is of metal with insulated dots and dashes. The Pen is connected with the Red Seal Dry Battery and the Wireless Practice Set. When the pen is drawn across the dots and dashes it closes the circuit, and the buzzer sounds. It is possible to attach a sounder to the outfit and get the telegraph click also. A practical and efficient way of learning wireless and telegraph signals.

List No.		Price.
303	Mesco Codegraph Set	$2.50
304	Codegraph Plate, Pen and Book	1.00

MANHATTAN ELECTRICAL SUPPLY CO.

New York, 17 Park Place. Chicago, 114 S. 5th Ave. St. Louis, 1106 Pine St.
San Francisco Office, 604 Mission St.



Mesco Flexible WIRELESS TRANSFORMERS

Will make wireless apparatus 200 per cent. more efficient. When short circuited or when charging condensers does not consume any more power than the magnetic shunt is set for. Can be connected direct to alternating circuit.

List No.	Capacity.	Secondary Voltage.	Pr.
330	½ kw.	5,000 v.	$15
363	¾ kw.	10,000 v.	20
331	1 kw.	20,000 v.	25

Mesco Wireless Receivers

Have powerful field magnets and thin diaphragms, and are very sensitive. Our No. 480 Double Head sets complete have been used in receiving commercial wireless messages over distances of 2,000 miles. All receivers are wound with silk-covered copper wire.

Best steel obtainable used in construction of the permanent magnets. Users have had head sets for five years and over without any deterioration in sensitiveness. This cannot be said of any light-weight receivers.

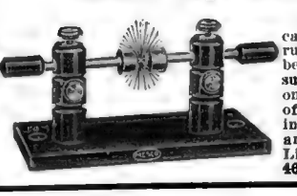
List No.		Price.
480	Double Head Band, with six-foot green silk cord and two receivers, 4,000 ohms each	$6.00

Mesco Wireless Practice Set

Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

List No.		Price.
342	Wireless Practice Set, with battery and cord	$1.50

Mesco High Efficiency Spark Gap



Adapted for stations up to ¼ K.W. capacity. Base is of polished hard rubber. Standards are of hard rubber composition of the highest insulating properties. Hard rubber ends on the brass rods permit the length of the gap to be varied, while sending. Spark terminals are of zinc, and are renewable.

List No.		Price.
465	High Efficiency Spark Gap	$3.00

"MIGNON SYSTEM"

Radio Signal Receiving Apparatus

R L C 2 Special

For Commercial and Amateur Wireless Stations

WRITE FOR CATALOG R5

R L C 4

Apparatus of Scientific Construction for the Reduction of Static Interference.

High Resonance

Unapproached Selectivity and Durability

R L C 3 Special

The "Mignon System" Radio Receiving Cabinets RC2—RLC2 Special—RLC3 Special and RLC4 are not guaranteed for the reception of continuous wave signals. However, through the persistent efforts of our untiring laboratory staff, they have been decidedly improved upon, with the gratifying result of being able to hear the above signals in our daily tests of apparatus before shipment is made. These signals will greatly improve by the shunting of a fixed or variable condenser of suitable capacity across the 'phone terminals.

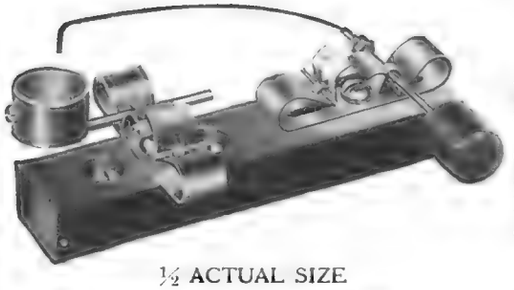
We receive many gratifying letters from our satisfied patrons verifying the above statement.

Mignon Wireless Corporation

Specialists in Radio Receiving Apparatus

127 West Market Street

ELMIRA, N. Y.



½ ACTUAL SIZE

POSTPAID, 50 CENTS

"SOME" DETECTOR!

Absolutely the **simplest** and **most practical Detector** of the Cat Whisker type yet devised. Lacquered Brass for the metal parts and Polished Fibre for the base. Has the usual merit of the "Winger" products.

Winger Electric & Mfg. Co.

711 So. Dearborn Street, Chicago, Ill.

QUESTION BOX.

(Continued from page 506.)

and dashes, the latter being somewhat more intense? 2. What form of winding is most efficient for a loading or coupling coil, the straight coil or the layer wound? 3. Wave length of tuning coil 10 inches long by 3½ inches in diameter, wound with No. 20 bare wire?

A. 1. The peculiar note you hear in your 'phones is due to the compensating wave emitted by arc transmitting stations. In this system the key is shunted around a few turns of the helix, and when the key is closed it throws the aerial circuit in tune, and when the key is raised the aerial is out of tune, but you can hear the waves emitted, although they are much weaker. This method of control is necessary when it is considered that the arc must be continually burning, and any interruption of the circuit would perhaps extinguish the arc. Therefore, all of the controlling is done in the aerial circuit, but no means can be used which will alter the amount of current drawn from the arc.

A. 2. The best form of winding for inductances in general is the single layer winding, as this cuts down the distributed capacity effect.

A. 3. The wave length of the tuning coil you mention is approximately 200 meters.

Miscellaneous Radio Phenomena.

(408.) Russell Baley, Hillsboro, Wis., desires to know: 1. Why it is that the color of his spark gap changes from blue-white to a yellowish hue when the aerial is disconnected from same? 2. An explanation of why a 220-volt, 75-k.w. alternator has the effect of attracting a 25-watt lamp suspended three feet above it. The latter being equipped with a tin shade.

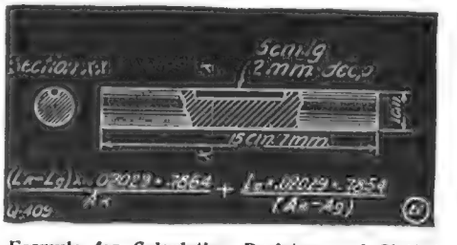
A. 1. When the aerial is connected to your spark gap it acts as a capacity and increases the intensity of the discharge, but when the aerial is disconnected this capacity is removed and the current merely arcs in the gap.

A. 2. The large generator, having a powerful magnetic field, will no doubt attract the lamp, due to the tin shade on same, but as the current also sets up a magnetic field around the lamp when it flows through the filament this may also be a factor in the attraction of the lamp. Magnetism might be set up in the tin shade, also, by induction currents flowing around it.

Resistance Formula.

(409.) Roy Ostend, Wurtsboro, N. Y., ask for a formula to be used in calculating the resistance of a rod, the dimensions of which are given in the attached illustration.

A. The formula for calculating this rod is given in the sketch.



Formula for Calculating Resistance of Slotted Bar.

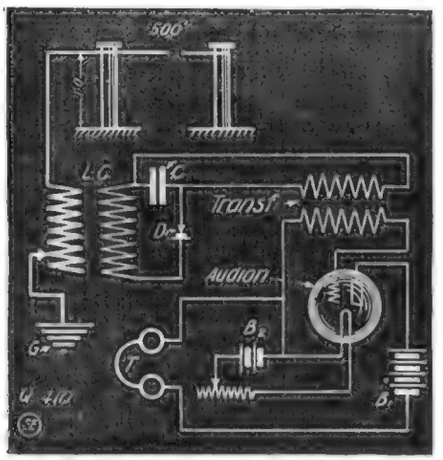
In this formula Lr is the length of the rod over all in cms., Lg is the length of the groove in cms., Ar is the area of the rod in sq. cms., and Ag is the area of the groove in sq. cms. The other figures are

constants. The resistance calculated by this formula will be the resistance of a copper rod of the above dimensions. Other metals may be figured by multiplying this result by the relation of this metal's resistance to that of copper. Thus, if the rod is of 18 per cent. German silver, the result should be multiplied by 18, because the resistance of this metal is 18 times as great as that of copper.

New Type of Aerial.

(410.) U. R. Fox, Dobbin, Tex., informs us that he has read of an antenna made by laying a wire straight on the ground, and that the inventor of this method was enabled to pick up Honolulu when the aerial was tried in California.

A. To the best of our knowledge the wire employed for such experiments is raised about one foot from the ground on posts and is insulated. In some cases the far end of the wire is grounded. We believe that this will work all right, provided a detector is used that operates on the current-effect principle and that the rectified current obtained be intensified by using one or two audion amplifiers. We are attaching



Single Wire Aerial and Audion Amplifier Hook-up.

an illustration which will no doubt be of assistance to you in your experiments.

Spark Coils as Open Core Transformers.

(411.) Peter J. Welcome, Port Jefferson, N. Y., writes us, asking several questions: 1. Why it is that he can obtain a spark from the secondary of his induction coil when same is connected direct to the 110 volt, alternating current mains and vibrator is screwed up tight? 2. Why it is that a small condenser connected across the 'phones has the effect of cutting out the signals? 3. What effect the wide spacing of his aerial wires will have on receiving range, and if the addition of more wires will increase the range?

A. 1. When a spark coil is connected direct to the 110-volt, alternating current mains and the vibrator is screwed up tight the coil will operate as an open core transformer; but it will be very inefficient, due to the fact that it is not properly designed for such work.

A. 2. The condenser connected across the 'phones should be in series with a switch, which will enable you to cut out the instrument under certain conditions.

A. 3. It will be of no advantage to add three or more wires to your aerial, for it should give very good results as it is, and the addition of more wire will not merely lower the inductance, but will increase the capacity also and the gain thereby will be very little.

Converting Transformers from Open Core to Closed Core.

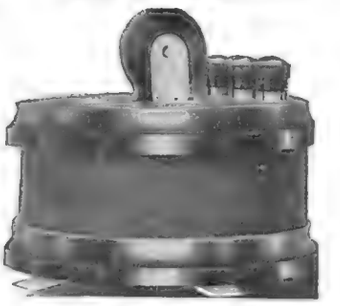
(412.) Lamar Boyett, Tampa, Fla., writes

CRYSTALOI

A PERMANENT WIRELESS DETECTOR THAT HAS MADE A WONDERFUL RECORD

The **CRYSTALOI DETECTOR** will do for you exactly what you would have a detector do. It will put you in touch with the *Distant Stations*. It is not affected by near By-Stations. It is capable of the finest adjustment and will last a lifetime if properly cared for. We guarantee every instrument to be and do everything we claim for it. Ask any one of the thousands that are using them—they are all for us.

TYPE AA. SUPER-SENSITIVE



DIMENSIONS 4" x 3½".

PRICE, $6.00

Mailing Weight, One Pound

CRYSTALOI—Type B $3.50—Postage, 10 Cents

OUR NEW MINIATURE WIRELESS CATALOG describing our complete line of Receiving Apparatus can be had for five cents in stamps.

REMEMBER WE ARE SPECIALISTS in wireless Receiving Apparatus and our products are of the highest grade obtainable.

EUGENE T. TURNEY CO., Inc
2595 THIRD AVENUE, NEW YORK CI Y

Here's the Most Sensitive Head-set for Wireless Work

On 10 Day Free Trial

Stromberg-Carlson Radio Head-Set

THIS set is guaranteed to increase the receiving efficiency of any radio station with which it is used, regardless of the type of head-set used heretofore.

This claim is based on comparative operating tests conducted at many stations. If you are skeptical, convince yourself by ordering a set for 10 days' free trial against all other makes. The price is $8.25, and your money will be given back at once without the slightest obligation if you are not satisfied.

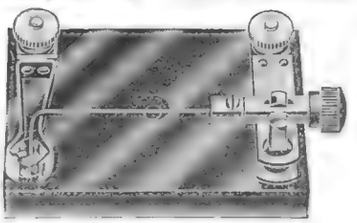
Dealers sell this head-set. If you cannot get it from your dealer, write us. Write today for free bulletin No. 1006.

Stromberg-Carlson Telephone Mfg. Co.
Rochester, N. Y. Chicago, Ill.

2 NEW BUNNELL WIRELESS SPECIALTIES

The Jove Crystal-Detector-Holder is the simplest, handiest and most perfect arrangement yet produced. It holds crystals without using clamp screws.

It firmly holds crystals of different minerals at the same time—change of contact from one to the other can be instantly made; a sensitive point quickly found, and the correct pressure held constantly, all without using a single screw or nut. It is designed and finished in our well-known high grade style. Mounted on dark enameled porcelain base with metal parts nickel-plated and highly polished.
Price, Net $1.00



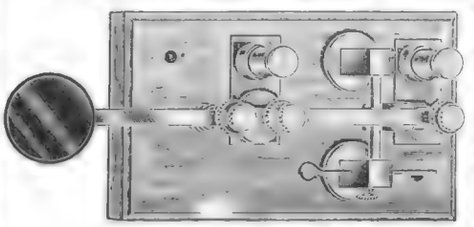
Jove Crystal-Detector-Holder.

The Straight-Line Renewable-Contact Radio Key is much superior to other types of Radio Keys.

Not only are the contacts renewable; but, no matter how much worn, full contact surface can be maintained between them, and the lever retains its normal horizontal position.

This is accomplished by mounting the upper contact on an adjusting screw, which is threaded through the lever and held in position by a check nut. The lower contact is so arranged that it may be loosened for adjusting.

By holding the lever down, with lower contact loose, and then clamping it, perfect surface alignment between the faces of contact pieces is secured, and thus fading or irregularity in strength of signals caused by varying resistance of contact points is eliminated and the contact pieces may be practically used up before renewal becomes necessary.



Straight-Line Radio Key.

Another desirable feature of our Straight-Line Radio Keys is the self-clamping binding posts with which they are equipped. These posts make loose connections impossible.

The Keys are mounted on heavy, polished marble bases (6 in. x 3½ in. x 1 in.). The metal parts are heavily nickel-plated and polished, making a strikingly handsome symmetrical instrument.
Price, with ⅛ in. hard silver contacts; postage weight, 4 lbs..... net, $7.50

Send for descriptive circular and copy of our Wireless Catalog.

THE J. H. BUNNELL CO., Inc., Electrical Manufacturers, 32 Park Place, New York City

This Highly Efficient Jeweler's TIME RECEIVING STATION

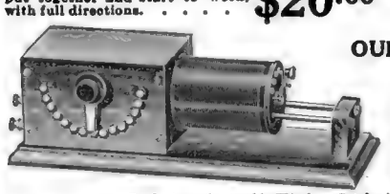
Will receive up to 2,000 miles

Regular Price, $33.00
Special for Jan. only... $26.00

In this set we have spared no expense or labor in construction. As a time receiving outfit it has no equal. The station is equipped with a 12-point loose coupler, rotary variable condenser, new feature adjustable detector, fixed condenser, large capacity loading coil, including a 2,000 ohm D. F. Headset.

All instruments mounted in a specially constructed oak cabinet 16½ inches long, 12 inches wide by 10 inches high over all. A buzzer is connected so as to enable you to secure proper adjustment in your detector in order to receive wireless. This station is fully guaranteed to give you satisfactory and reliable service

Complete Parts for this Station all wound and drilled ready to put together and start to work, with full directions. $20.00



OUR JOVE RECEIVING TRANSFORMER

Regular Price, $8.00; for January only $5.00

This is a very superior transformer. Has 15 taps brought out to contact points mounted on the side of the primary cabinet and controlled by a quick acting radial switch—making rapid variation a feature. The secondary is wound with fine silk covered wire having 6 taps brought out to the contact points on the end of the drum and controlled by a quick acting, self-adjusting spring type lever. The secondary is direct connected to binding posts mounted on the back of the primary cabinet, thus avoiding noises in the receivers and breaks in the message due to loose and imperfect contacts.

COMPLETE PARTS, all wound and ready for assembling, $3.50

Send stamp for our big Wireless Catalog "E" and free code chart made of unbreakable fibre.

Universal Wireless Co. 19 E. 32 Street N. Y. CITY

All "Universal" sets are sold with 10-day trial privilege and money back guarantee. Prompt shipment guaranteed.

RADIO = UN = DAMPED = WAVER

DO YOU WANT TO HEAR?

Nauen, Hanover, San Francisco, Honolulu, Darien, Sayville and Tuckerton on just an ordinary aerial . . . .

You can do it on our instrument

TEAR THIS OUT AND SEND FOR CIRCULAR

UNIVERSITY APPARATUS CO. 275 MORRIS AVE. ELIZABETH, N. J.

us, asking for instructions for converting a transformer coil into a closed coil transformer.

A. This may be very easily accomplished by following the design shown herewith. A

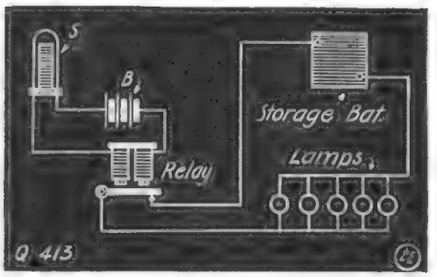
Making Closed Core Transformer from Transformer Coil Secondaries.

square core should be built up of transformer iron in the usual manner. It should be made of such dimensions that it will fit inside the secondary of the transformer coil, the holes in which measure 1½ inches in diameter. The core should be insulated under these coils with three or four layers of Empire cloth or silk. The primary consists of four layers of No. 16 D. C. C. wire wound on the opposite leg of the core, as shown.

Automatic Control of Sign Lights.

(413.) J. F. Jones, Ontario, Canada, wishes information on a method by which he can control electric lights on a sign placed some distance from his home. The arrangement is to turn the lights on at night and switch them off in the morning and is to be used for advertising purposes.

A. One of the methods by which this can be accomplished is to use a selenium cell, and the sketch herewith shows the wiring to be used. The cell is shown at S; B is a battery of 10 or 15 volts (determined by experiment), a relay and a storage battery supplying the lights. During the daytime the current will be flowing through the selenium cell and the relay will hold the contacts open. At night the cell will increase its resistance and the contacts will be closed, thus lighting the lamps. The circuit will again be opened in the morning as soon as the sun's rays strike the selenium cell.



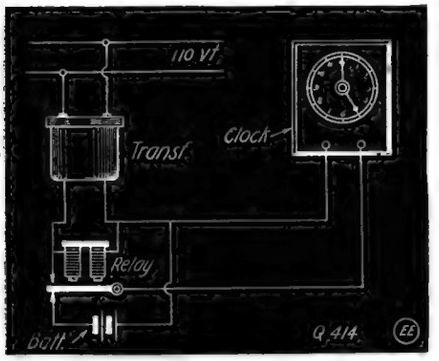
Using Selenium Cell to Turn Lamps On and Off at Sunrise and Sunset, Respectively.

It is well known that a selenium cell becomes more or less fatigued when exposed for long stretches at a time to strong light and will fail to respond; to offset this we suggest the use of a cell shielded by a

semi-opaque substance, which will prevent the direct rays of the sun from falling on same, and thus the life of the cell will be appreciably increased.

Automatic Clock Switching Mechanism.

(414.) Irwin C. Ryan, Elgin, Ill., writes us, asking for a method whereby he can



Relay Scheme for Transfer of Power to Electric Clock.

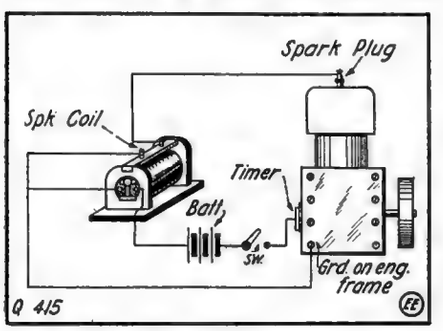
switch an electric clock, that is normally operated from a step-down transformer, to a set of batteries when the alternating current is cut off by accident or otherwise.

A. We are giving herewith a diagram of an arrangement by which you can switch your electric clock from the transformer mains to batteries, so that the clock will not stop when the lighting current goes out of commission. The method shown utilizes a relay. As long as the lighting station supplies current the armature is held away from the contact and the clock is operated by alternating current. However, should this circuit be opened, the armature will drop, making contact and thus closing the circuit through the batteries. When the alternating current starts to flow again, the armature will be attracted, thus breaking the circuit. The relay used should have a resistance of about 1,000 ohms to prevent undue draw on the transformer's secondary, and the spring on the armature of the relay should be very carefully adjusted.

Gas Engine Ignition.

(415.) Elmer D. Gehman, Macungie, Pa., wishes information on how to connect a spark coil to a single cylinder gas engine for ignition purposes.

A. The accompanying diagram shows the method of wiring an ordinary spark coil to a gas engine for ignition purposes. The hot spark delivered by these jump spark coils



Jump-Spark Coil Hook-up for Gasoline Engine.

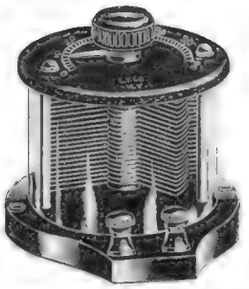
will prevent, to a large extent, carbon deposits and will give more power in the engine.

General Radio Queries.

(416.) Harold Brown, Walden, N. Y., asks: 1. Can a rotary spark gap be used

Chicago Wireless Headquarters

CLOSING OUT LARGE LINE OF RAW MATERIALS, PARTS, Etc.



ROTARY VARIABLE CONDENSERS

Only transparent rotary variable condenser made that can be screwed down, filled with oil to increase capacity and has binding posts on bottom where they belong. The 43 plate condenser has a capacity of .001 m.f. The 17 plate has a capacity of .0003 m.f.

No. 9240—17 Plate Rotary Variable Condenser, $2.25
No. 9241—43 " " " " 3.75

No. 10. TUNGSTEN FLASHLIGHT
6 inches long, complete .....65c.
Extra battery....20c. Extra bulb....15c.

60 and 100 Watt Nitrogen Lamps use less current; give white light.
60 Watt.....85c. 100 Watt.....90c.

No. 125. TUNGSTEN NICKEL VEST POCKET FLASHLIGHTS with Tungsten bulb and Ever-Ready Battery, complete.....45c.
Extra bulb, **15c.** Extra battery, **20c.**

FINE **50c.** POCKET CIGAR LIGHTER. Turn the wheel. Flint good for 5,000 lights. (2 for **25c.**), or each **15c.** New Flints, **5c.** 6 for **25c.**

We carry a very complete line of Wireless Apparatus in stock, being Chicago headquarters for the Electro Importing Co. Same prices, same goods and Free Wireless Course. Lionel Trains, Motors, Transformers, Wireless Outfits, Structo Metal Building Material, Automobile and Electrical Supplies. Send 4c. in stamps for complete catalogs.

LA SALLE LIGHT COMPANY, 134-136 N. La Salle St., Chicago, Ill., Opposite City Hall

You Can Only

secure the best in **FLASHLIGHTS** and BATTERIES by insisting that this trade-mark is on flash-light-case and battery. If your dealer cannot supply you with our product write directly to us for Catalogue A2.

"Cigarette"

Beacon Flashlights and **Batteries** are made in a wide variety of styles and shapes but only one quality—**THE BEST.**

"Ideal Fountain Light."

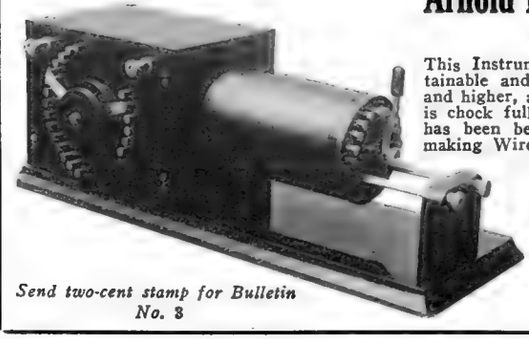
"Short-Circuit Proof."

Beacon Electric Works of National Carbon Co., 118-20 DUANE STREET NEW YORK

BRANCHES: CHICAGO, SAN FRANCISCO

Arnold Navy Type Loose Coupler

PRICE, $15.00



This Instrument is made of the best Material obtainable and is equal to others selling for $18.00 and higher, all fancy prices and frills are eliminated, is chock full of value and is made by a man who has been before the public for the past 5 years making Wireless apparatus.

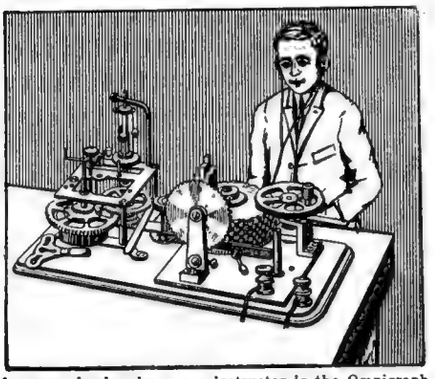
It will tune up to 3,500 meters.

I also stock the finest line of switch points, Hard Rubber knobs, Cabinets and accessories on the market. Prompt delivery of all orders has distinguished me.

Send two-cent stamp for Bulletin No. 8

J. F. ARNOLD
135 East 119th Street
New York City

LEARNING TELEGRAPHY



becomes simple when your instructor is the Omnigraph Automatic Transmitter. Combined with a standard key and sounder or Wireless Buzzer, it will send you telegraph messages at a slow speed, which can be increased at will to match the sending of an expert operator as you become more proficient. Adopted by U.S. Gov't. Made in 4 styles, from $2.50 up, all accurate. Circular free.

Omnigraph Mfg. Co., 39 L Cortlandt St., New York

BIG REDUCTIONS HERE

During the month of December, we are shipping our regular high-grade receiving transformer for only $4.25.

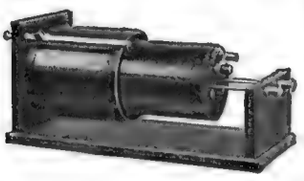
Stromberg-Carlson 2000 ohm headset and our receiving transformer only $10.75.

DeForest RJ-4 Audion detector and our receiving transformer only $19.95. RJ-5 Audion detector and our receiving transformer only $26.50.

Send 2-cent stamp for Bulletins 105 and 106.

COLBY'S TELEGRAPH SCHOOL
AUBURN, N. Y.

LOOK! A NEW CHAMBERS COUPLER No. 744, PRICE ONLY $4.50

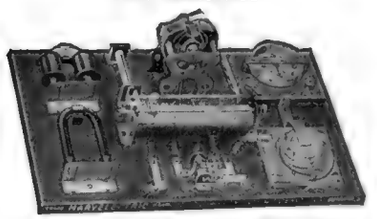


Positively unequaled for the money. Is 6" high, 6" wide, and 14" overall. Wound with Enameled wire, and has a very unique slider. Woodwork mahogany finished. Try one, you will not be disappointed.

5c. in stamps brings our 64-page illustrated catalogue, B-B-24. None otherwise.

F. B. Chambers & Co. 2046 Arch Street Philadelphia, Pa.

BOY ELECTRICS
Knapp Marvelectric
THE GREATEST



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More fun, more information than a hundred books. Finished as shown. Demonstrates Magnetism, Solenoids, Resistance, Motors, Dynamos.

Price $3.75

Live dealers everywhere. Order direct, or ask your dealer to show you the Knapp Line and insist on getting Knapp Goods.

Dealers not already handling the Knapp Line should ask for prices.

Catalogue illustrating many specialties on request.

KNAPP ELECTRIC & NOVELTY CO.
523 West 51st St. N. Y. CITY

with a small spark coil? 2. What is the wave length of his aerial 125 feet long and having a mean height of 43 feet? 3. The best size aerial to be used for all-around amateur work.

A. 1. A rotary gap cannot be used on a spark coil, due to the fact that the interruptions in the primary occur independent of the time when the plugs on the gap are in the sparking position, and if no plugs are opposite when the break occurs no spark will occur and the note will thus be badly broken up and distorted.

A. 2. The wave length of the aerial you describe is approximately 250 meters.

A. 3. For all-around amateur work it is advisable to have two aerials, one between 250 and 500 feet long and comparatively low, say, 40 feet, and the other about 80 feet long and 70 to 80 feet high. The former is to be used for receiving long wave lengths from high-powered stations, and the latter for transmission purposes and the reception of amateur signals.

Direct Current on Arc Lamps.

(417.) Osmond S. Ryer, Pasadena, Cal., wishes to know: 1. Why alternating current is changed to direct current for operating motion picture machines? 2. How motor generator sets change alternating current to direct current?

A. 1. Direct current has been found to be superior to alternating current for feeding arc lamps, due to the fact that less current is consumed, and the light emitted is much stronger and whiter than from arc lamps operated on alternating current.

A. 2. A motor generator set consists of an alternating current motor and direct current generator mounted on the same base with their shafts connected. The operation of this machine is as follows: The alternating current is fed to the motor and, of course, drives same. This motor, in turn, drives the generator which generates direct current and is used on the arc. The alternating current does not flow over the shaft of the machine, and there is no electrical connection between the two machines.

HUTCHISON, EDISON'S CHIEF ENGINEER, ON NAVY BOARD.

Dr. Miller Reese Hutchison, of Llewellyn Park, West Orange, chief engineer for Thomas A. Edison, recently received appointment to membership on the Naval Advisory Board. Dr. Hutchison is the second to be appointed by Secretary Daniels, the first being Mr. Edison. Other members of the board have been selected by groups of scientists.

Dr. Hutchison was born in Montrose, Ala., Aug. 6, 1876, and was educated at the Marion, Ala., Military Institute. He took a technical course in the Alabama Polytechnic Institute, and was graduated in 1897. While in school he invented a device for assisting the deaf to hear that won him recognition. He attended the coronation of King Edward in 1902 and was presented by Queen Alexandria with a gold medal in recognition of a device he invented that helped her to hear, for she was quite deaf.

He is a member of the American Society of Mechanical Engineers, the Society of Automobile Engineers, the American Institute of Radio Engineers, the National Geographic Society, the Engineers Club of New York, the National Institute of Social Sciences, the New York Electrical Society, the American Society of Naval Engineers, the Navy League of the United States, and the American Association for the Advancement of Science.

A DANDY LIGHT

which won't start fires, and which stays lit in the rain or in the wind; that's what you've always wanted—haven't you? No matches, no wires, just a big, bright, powerful white light to help you find your way at night along dark streets or dim hallways—a light you can depend on always.

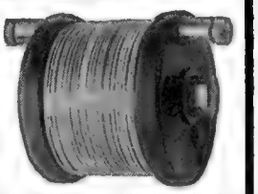
FRANCO

FLASHLIGHTS

can't be beaten. They are the finest produced and were awarded *Highest Honors* at the *Panama-Pacific Exposition*. With our Radio Batteries, they give a wonderfully bright light that lasts a long time. You can't find a more useful gift for Christmas. Look the assortment over at your dealer's or write us for a big illustrated catalog No. 9.

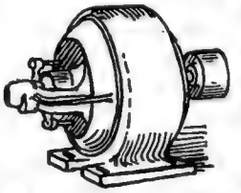
Interstate Electric Novelty Co.
29-31 Park Place, New York
Chicago San Francisco Toronto

"MONOTONE" QUENCHED SPARK GAP



This is positively the last chance to obtain the Monotone Gap at our special Christmas price at $1. After this month the regular price of $1.50 will be in force. Ask any leading experimenter for his technical opinion of this gap in single units, as illustrated, for spark coils, two units per every quarter K. W. power of transformer. Gaps will be shipped in the order of receipt of $1 bill or P. O. money order.

K. RICHARDSON, BOX 686, ERIE, PENNA.



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Boston Receiving Transformer, $7.50
" Variable Condenser, 25 Plates, $2.75
Boston Detectors, $1.00, $1.25, $1.75, $2.25, $4.00

Agent for Electro Importing Co. and A. W. Bowman Co., Manhattan and Adams Morgan Spark Coils, Ever-ready flash lights and batteries.
Catalog for stamp only.
M. MUELLER, 18 Devonshire Street, BOSTON, Mass.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

TELEPHONE DIAPHRAGM.

(39.) C. G. Black, Worcester, Mass., has sent us a sample of a telephone receiver diaphragm perforated in a certain manner. Our correspondent claims that by so perforating it will become more sensitive, particularly when used for receiving wireless telegraph signals.

A. We have examined the diaphragm and we have also tested it, and admit that it works slightly better than the ordinary receiver diaphragm. We should think that it would be possible to exploit this commercially, as an article of this kind is surely in demand.

We would advise our correspondent to apply for patent on this device, but it would perhaps be a good idea to first have a search made to find what has been done in the art before. There are a great many telephone receiver patents as well as patents on telephone diaphragms, and it is always safe to investigate what predecessors have done in the art.

REINFORCING STEEL RAILS.

(40.) J. M. Bennet, Mt. Washington, Pa., sends in a device on reinforcing steel rails for heavy track service. He also encloses a detailed drawing on same and wants to know if the invention is patentable and practical.

A. Devices of this kind are in use practically all over the world wherever the tread has to stand a heavy load. There is nothing new to this and it is being used in ordinary every-day practise.

DETECTOR.

(41.) Fred R. Bullis, Omaha, Neb., submits an idea on a new detector whose operation is based upon using sponge platinum in a certain manner.

A. Without practical research work it is impossible to state if the device will work or not. On wireless detectors or any device of this kind speculation is of little use, as it is impossible to foretell whether such a device will work or not. The scheme looks feasible on paper the way our correspondent puts it, but as stated before, without practical experience it is fruitless to go into the merits of the invention. We would advise our correspondent to experiment with the device, by all means, and in case encouraging results are obtained apply for patent. This is the best suggestion we have to offer now.

INTERCOMMUNICATING 'PHONE.

(42.) S. A. Vedri, New York City, has invented a new intercommunicating direct-line telephone which is supposed to do away with the ordinary telephone receiver, the idea being that by pressing a button the sounds will come out of a horn. A super-sensitive transmitter is used, so the person does not actually have to speak into the mouthpiece but can be as far as 2 feet away from it. He wants to know if such a device is practical and whether there is a demand for same.

A. Without knowing the full details of this scheme it is impossible to say whether a device of this kind can be patented or not. The mere idea of using a loud-talker in connection with a very sensitive microphone does not entitle you to a patent, as such devices have been used right along in every-day work. If, however, the interior (operating) mechanism of the telephone represents a new idea not having been used before, a patent might be obtained. We advise you to get in touch with a reputable patent attorney to look up the art and see what has been done previously.

FRANCE TO MOBILIZE INVENTORS ALSO.

A minister of inventions whose duty it is to effect a mobilization of the inventive genius of the country is the latest project of the French Government. It is one of the new necessities of modern warfare just as England's new minister of munitions. The plan is similar in some respects to that adopted in America by the formation of the naval advisory board.

From this it must not be inferred that France is suffering from a dearth of war inventions. It is quite the contrary that has given rise to this fresh need. The principal task of the minister will be the sorting out of the more important of the thousands of war devices with which the French patent office is being flooded and the quick placing of them at the disposal of "la patrie."

X-RAY MAY STOP CANCER'S RETURN AFTER OPERATION.

That the X-ray apparently has no effect on cancer itself, but that it will stimulate the growth of lymphocytes, a sort of white corpuscle, and thus prevent a recurrence of cancerous growth, was stated in a paper read by Dr. James B. Murphy, of the Rockefeller Institute to the members of the National Academy of Sciences at the American Museum of Natural History recently.

Dr. Murphy reached his conclusions after many experiments with rats. The treatment, he hopes, will be found of value when applied to humans from whom cancerous growths have been removed.

PATENT YOUR IDEAS
There is a Constant Demand for Good Inventions
"WHAT TO INVENT"
and "How to Obtain a Patent"
These Books sent FREE
If you have an invention, send sketch for free report regarding patentability; if not, send for free book, "What to Invent."
From our advertisements in newspapers manufacturers are constantly writing to us regarding the purchase of patents. Their names and addresses are furnished our clients free of charge. We advertise your patents for sale at our expense.
DON'T WAIT! Your invention will never do you any good if some one else patents it ahead of you. Write to us NOW.
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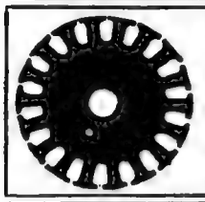

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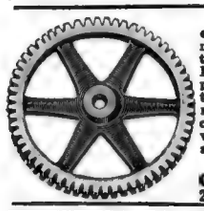

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PERPETUAL MOTION, THE FOLLY OF THE AGES.

(*Continued from page* 480.)

chine must of necessity be supported on spindles or shafts resting in bearings. These bearings are bound to exert some frictional effect, and the following formula gives the loss in foot-pounds per minute for such horizontal bearings. This rule states that the loss in foot-pounds per minute is equivalent to .2618 times the coefficient of friction, times the weight on the journal in pounds, times the diameter of the shaft in inches, multiplied by the revolutions per minute at which the shaft rotates. The value of the coefficient of friction varies, of course, but it has a value of approximately .008 for a cast-iron shaft running in a steel box or sleeve when the pressure is 100 pounds per square inch, and, considering that sperm oil is used as the lubricant.

Many people who have a slight knowledge of physics have promulgated designs for perpetual motion employing liquids, somewhat after the fashion shown in Figs. 2 and 3, and some of these machines have appeared to be very ingenious on first inspection. However, friction is also present here, as liquid cannot flow through a pipe or nozzle without encountering a reactional or frictional effect.

A number of electrical machines intended to produce perpetual motion have been devised from time to time, and Fig. 4 depicts a design which might appeal to the amateur electrician or inventor. This instrument is of the electromagnetic type, and A represents a frictional electrical machine. At B there is a crank connected to a pivoted armature situated in front of the electromagnet C. The frictional electric machine is started and so magnetizes the (temporary) magnet, which pulls the armature G toward C; the circuit is broken at E, and thus the magnet loses its power, temporarily. The spring J now pulls the armature back against the contact screw E, and thus the magnet is energized once more. Thus the action is supposed to keep up forever. The explanation previously given in connection with the motor-generator set illustrated in Fig. 3 will help to elucidate the fallacy here involved. Besides a static machine cannot operate an electromagnet.

Another inventor devised a magnetic wheel machine, pictured at Fig. 5. This wonderful machine constituted a rotating wheel having oppositely disposed magnetic segments, such as those made of iron (A), while a powerful steel magnet acted on these wheel segments in turn. Attached to the wheel shaft was a crank motion which alternately and in proper sequence raised and lowered a magnetic shield (B) in front of the permanent magnet poles, so that as soon as the iron segment approached the magnet the shield would be interposed between them, and the momentum of the wheel would carry it past this point, etc. This action was repeated *ad infinitum*, as will be apparent. The most remarkable claim made by the inventor of this particular device was that the magnetic shield was to be composed of brass, coated with a "chemical and mineral substance" which would make it an insulator of magnetism. (As a matter of fact there has never been found a substance to insulate magnetism, except iron.) Again, the wheel C attached to the shaft of the device turns in a trough of water, as perceived, and it is supposed to serve in equalizing the motion, thus keeping the machine from running away with itself and committing self-destruction!

One of the "simplest," apparently, solutions of the perpetual motion problem and devised at an early date involved the use of some form of revolving wheel made up with spiral paths in same, in which paths

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a number of metal weights or balls could travel back and forth as the wheel rotated, and thus change their center of gravity. This would eventually overbalance the wheel proper, it was claimed, so that they would produce a greater force on one side of the wheel (in a descending sense) than that offered by the balls being raised on the other side of the wheel. This is shown very clearly in Fig. 6. Moreover, the friction and windage of the rotating member proper, with respect to the bearings, etc., have to be taken into account, even though it is placed in a vacuum, as gravity will cause the wheel to exert weight on the points of suspension which would, of course, be the bearings. Disregarding these facts altogether, it can be seen that although it looks quite certain that the balls falling out along the spiral grooves of the wheel at the right will surely tend to exert a greater force "downward" in a turning effort on the wheel than the counteracting "lift" force required to raise the balls as they move backward to the center of the wheel, such is not true.

It will be found upon critical inspection of all such wheels that, although some of the weights or balls are more distant from the center of the wheel than others, yet there will always be a proportionately smaller number of them at that part of the wheel on which they exert the greatest power, so that these exactly counterbalance each other and hence the wheel will stand still. Hundreds of similar designs employing liquids, such as water, mercury, etc., bellows, weighted collapsible leaves and what not, have been devised and thought out to bring about the much-desired function of "perpetual motion," but without avail.

Of later years and in view of the marvelous characteristics of radium, for instance, which was supposed at one time to give off energy forever, there have been many pseudo-scientists who, in speaking of perpetual motion, simply mention the word, Radium! as if they had solved the whole question finally and completely. The latest research work on radium has brought out the fact that it eventually loses its power to give forth energy in the form of electrons at the end of about 2,500 years. To some of us no doubt this would seem near enough to the goal of the perpetual motion dreamer, and a radium clock would seem to put any of the devices of this ilk invented in past years away in the shade. A radium clock that undoubtedly will work all right has been devised by Prof. Struts. This may be said, without a doubt, to be one of the nearest ap-

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proaches to a practical perpetual motion device ever invented. It comprises a glass bulb, as perceived in Fig. 7, inclosing a gold leaf electroscope, some radium salts and a metal wire which has one end connected to the earth. The action is as follows: The emanation of the radium in the form of electrons shot forth at high velocity, charges the leaves, which diverge slightly, until one of them touches the wire at A. As this terminal is connected with the ground, it carries off the electrical charge, leaving the gold leaf discharged, but which are then recharged from the electrons continuously given off by the radium. This charge is again carried off to earth, and so on, *ad lib.* No doubt a suitable electrical contact of delicate mechanical construction could be arranged so that every time the leaf touched the wire A it would cause a secondary electrical circuit to operate some electromagnetic device connected to a standard clock mechanism. Also it might be possible to construct a sufficiently sensitive mechanical arrangement inside the bulb, which would be actuated by the movement of the gold leaves as aforementioned.

The life of such a clock would be 2,500 years, if our present knowledge of radium and its characteristics are correct. Thus we see that, in so far as practical results, or in fact any results worth mentioning are concerned, the problem of perpetual motion is practically as far from solution as it ever was since the dawn of creation.

Wherever you find practical engineers and scientists at work in the laboratory or in the field, you will always find some practical form of energy being utilized, either from waterfalls, some form of gas or coal, mineral oils or windmills, etc. There are a number of mighty forces as yet unharnessed in nature, which so far have baffled the many master minds trying to solve their mysteries; notable among these there is the almost unbelievable force available in the ocean waves, which perpetually wash our shores; the energy in the sun's rays, which has been used practically in some apparatus devised in the past few years, but not to any extent worth mentioning; the efficient use of wind energy, and the direct generation of power from coal, which at present entails 90 to 98 per cent. loss in boilers, engines and piping. But let the perpetual motion specialists dream on, for he who never dreams never accomplishes, someone has said.

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(*Continued from page* 485.)

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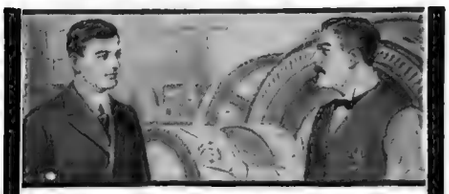

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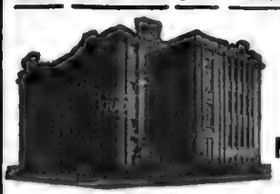

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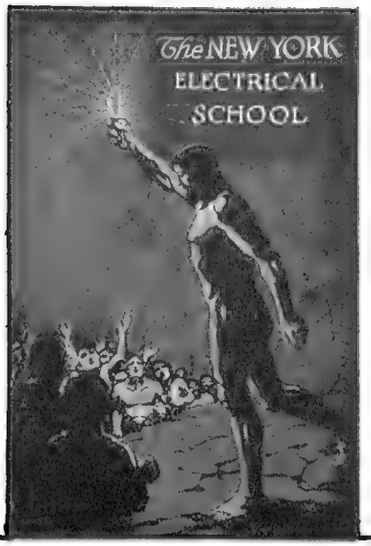

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(*Continued from page* 488.)

Referring again to Fig. 2, transformer T, condensers C^3 and C^2, may be eliminated and the simplified Armstrong circuits connected together at junction point O, Fig. 2. Transformer T (in Fig. 1) may be compensated for by increasing the telephone inductance. This may be accomplished by using telephones in the neighborhood of 3,000 or 4,000 ohms; although telephones of 1,000 or 2,000 ohms may be used, it is advisable to use the higher ohmage, with its corresponding higher inductance. This somewhat simplifies the arrangement, giving practically the same results. After the apparatus are all connected up the following instructions should be followed in adjusting the instruments to any given station.

Set condenser C^5 at its maximum capacity, inductance coil L^1 at zero, and tune the primary inductances and inductance coil L, condenser C and grid condenser C^1 until the incoming signal is at a maximum, then increase inductance coil L^1 (which will increase the signal strength many times) until the audion is below the point of generating. Finally decrease condenser C^5, keeping the audion below the point of generation until the maximum strength of signals are realized. This indicates that the limit of amplification is reached, and beyond this it is impossible to go. When connecting the secondary terminals to the grid coil and junction point O, a trial should be made to determine which side of the secondary connects to the junction point O, as it makes a slight difference in tuning.

A simple test to determine whether the audion is oscillating is to *touch the grid connection* (where it leaves the audion) *with the finger*. If a sharp click is heard in the telephones the circuits are oscillating. This condition is necessary in order to receive the "undamped waves," utilizing the "heat" principle.

All connections should be of stranded wire. While the dimensions given are for the longer wave lengths, apparatus may be constructed for wave lengths of 200 meters and up by simply making the wing and grid coils L and L^1 much smaller with finer graduations of inductance. In this case the loose coupler will obviously require taps or sliders, using No. 24 wire on the primary of the coupler. The rest of the apparatus remains the same. This type of apparatus and connections are well worth constructing and using, as it constitutes the most advanced means known at the present time in the reception of both damped and undamped radio signals.

ELECTRICAL SEWING MACHINE MOTOR STAYS WHERE YOU PUT IT.

(*Continued from page* 484.)

ter of gravity of the whole motor and pedestal is so balanced out that when the friction pulley of the motor shaft is placed underneath the hand-wheel of the sewing machine, it will drive it without the motor tilting upward at the back, as might be suspected on first sight. The motor comes with plug and flexible cord so that it may be attached to any convenient lamp socket. It is furnished wound for any commercial voltage or frequency. The manufacturers of this unique motor drive for the sewing machine claim that it performs its duty all day without getting out of alignment, and it should indeed prove a boon to those who have any extended use for such a labor-saving device.

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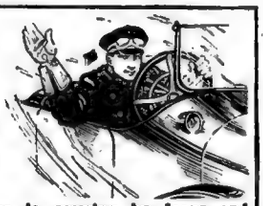

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THE POINATOWSKI RAY.

(*Continued from page 473.*)

approaching from Zapata came a chance shell among Rutherford's men, and exploding, wrecked the projector, put Captain Cawthorne to the ground and killed three others. Kilroth sprang to his Captain, slipped his arm under his head and asked: "Where are you hurt, Captain?"

"Leg smashed again," grinned Cawthorne. "Get me the other if you can, Kilroth!"

Kilroth glanced at the debris of shattered poplar and steel wire which had been his Captain's false leg, and with a muttered "Thank God!" dashed away to the supply auto, where a substitute had been carried. As he came back Cawthorne was sitting up gazing ruefully at the wrecked projector.

"It all depends on the Admiral now, Kilroth. We're out of the game, except for the Nullifiers. They can probably protect us in our retreat to the Rio Grande."

"Hard luck!" grunted Kilroth. "They should have let us have both projectors. Four hundred troopers with only one effective weapon sent out againt 20,000 of the enemy—not counting their fleet."

The Colonel came up, glanced at Cawthorne adjusting the fastenings of his false leg, and exclaimed: "I didn't expect to see you able to move. It's fortunate for all of us that you were not injured."

Cawthorne shrugged his shoulders. "The only possible use I have been to your command, Colonel, is smashed out of commission—almost out of recognition." He pointed to the wrecked projector and added: "I suppose that means that we draw out of the game now?"

"Only as far as that cañon!" asserted the Colonel grimly. "We must have cover from the battleships' guns. They're getting into action now, and when they get our range we must be behind rocks."

He gave the command: "Leave those big guns and retreat instantly to that cañon! Signal Nullifier No. 3 to draw back here. We must not risk both those machines at the same time. Order Nullifier No. 4 to continue operating over the enemy's trenches."

Then to the wireless operator he ordered: "Call up Admiral Roberts' flagship and report that our projector is wrecked. Tell him that we will hold our position here, and if he succeeds in exploding the mines and coming up into the bay to engage the enemy's fleet, we'll keep our Nullifiers in action on the land enemy at Zapata."

And a rapid command to Cawthorne followed: "Captain, have the muzzles of those big guns elevated so as to draw any enemy's fire. Also leave that rapid-fire gun among them. Attach the wireless firing mechanism to it, and then draw off every man into the cañon!"

The retreat, or perhaps side-step, was quickly made, and with the rugged, hoary Chapaderas Range between them and the coast, the command, with horses and supply autos, were safe from the fleet guns, the shells from which, however, were directed at the five great wooden counterfeits and the smoke from the rapid-fire, which were clearly visible from the bay across the open mesa.

"That deceives them, all right," laughed the Colonel, "and if we keep quiet here for a while they'll believe that they've wiped us out completely. There go the guns!" as a shell exploded and scattered the images over the plain.

A scout aero was signaled to come down, and as it reached level ground at the mouth of the cañon the wireless officer reported an answer from Admiral Roberts:

"Our projector has destroyed apparently every mine and several submarines. Am advancing up the bay to

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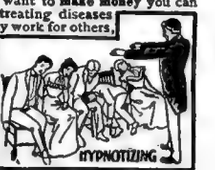

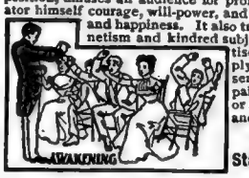

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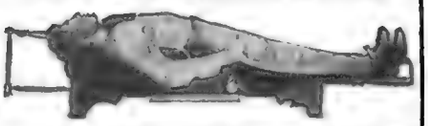

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engage the enemy's fleet, and shall then proceed to Zapata to take the land forces. Hold your position until I arrive. It will be safer than retreat."

The Colonel scowled grimly as he handed the paper to Cawthorne. "The Admiral assumes that he gets not only the surrender of the fleet but of the entire land force; and we are to sit here and wait till he comes in to protect us. Fortunately we are not under his orders. Cawthorne, step this way for a few moments."

Ten minutes later the two officers grasped hands, their faces beaming, and Cawthorne strode over to the scout aero, climbed into a seat and went into the air, heading across the great Cisneros Bay. With him were the operator and a wireless man.

They passed directly over the Japo-Chinese fleet—16 battleships, seven of which were the most modern and powerful dreadnoughts ever designed. Every vessel was under steam, and while two had run up close to the Zapata shore in order to meet any further attack from Rutherford's command the other great ships were speeding down the bay toward the point around which Roberts' fleet would have to come.

The aero flew swiftly, and the 18 miles to that point were quickly covered. Beyond it they saw the Stars and Stripes floating from the fleet, which was moving very slowly. One vessel only—a light cruiser—was pushing ahead, and through his glasses Cawthorne saw the big projector tube at the bow. Almost at that moment the cruiser slowed down as her nose poked round the great perpendicular Vaquera Rock, which had obstructed any view of the enemy, and as she reached that position the projector tube was swung over to port, pointing at the approaching Jap battleships, four miles up the bay. With a gasp of delight Cawthorne saw the puffs of smoke from every turret of those vessels, and the next instant the crash of the detonations reached them.

"Firing down the bay with not an enemy in sight except that cruiser!" ejaculated Cawthorne. "And they haven't had time to aim at her. Roberts gave the order for that firing, and the ray—the wonderful Poniatowski Ray—did it!

At the rear of the enemy's battleships were several light-armored cruisers which, as the ray reached them, exploded their magazines.

"Absolutely unnecessary!" growled Cawthorne. "He's using too heavy penetration. I was afraid of that, and warned them against it. If they concentrate much more than they're doing, they'll get through the heaviest armor to the magazines and blow up those dreadnoughts, and our good old country'll lose them all."

But the Admiral must have ordered less penetration, for no more magazine explosions took place. For a few moments the battleships were maneuvered to bring their turret guns to bear upon that one mysterious cruiser in the shadow of the great Vaquera Rock, but before any gun could be aimed or elevated or depressed the ray struck the charge and discharged it. In less than three minutes the firing ceased and the United States battleships were under forced draft, dashing round the point.

Cawthorne howled delightedly to the wireless officer: "Send word to the Colonel that Roberts is steaming up the bay. All firing ceased." Then to the operator: "Work up the bay and over Zapata!"

As they glided over the great horde of tents, supplies, munitions and men Cawthorne waved a white flag until an answering flag showed that he would be received. They glided to the ground, and the Captain was escorted to the Allies' headquarters and received by Ito, the Japanese General, who understood English perfectly.

(*Continued on page* 521.)

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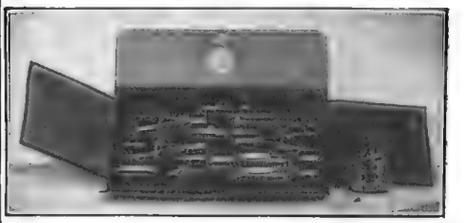

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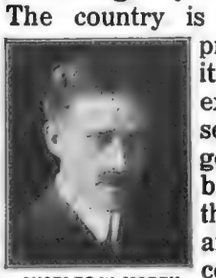

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THE PONIATOWSKI RAY.

(*Continued from page* 519.)

Cawthorne stated his mission concisely and very determinately. "Your fleet is silenced, General, by the marvelous ray projector which Admiral Roberts has, a duplicate of which destroyed your aero fleet to-day. The power of that ray has not been fully demonstrated to you yet, for if the penetration was increased to capacity it would explode every magazine behind the heaviest armor on the greatest dreadnought out there.

"And if we put our land projector into action again against your camp here, not one grain of explosive will escape. Your entire force will be annihilated! I am ordered by my commanding officer to demand your unconditional surrender!"

An hour later two wireless reports were sent to Washington. One, from Admiral Roberts, was:

"The enemy's fleet has surrendered with every battleship intact and little loss of life. Three of their cruisers destroyed. No loss on our side.

"ED. S. ROBERTS,
"Admiral of the Fleet in Cisneros Bay."

That from Colonel Rutherford was:

"The entire land force of the enemy at Zapata surrendered to this command at 4.45. Our projector destroyed early in the operations, but the Nullifiers completed the attack.

M. J. RUTHERFORD,
"Colonel of the Cisneros Expeditionary Force at Zapata."

ELECTRICAL HELPS FOR AMATEUR PHOTOGRAPHERS.

(*Continued from page* 493.)

thing must be sharp and distinct, is not like taking a snapshot out of doors in bright sunshine.

Before thinking of anything else you should select the "viewpoint" for your picture, whether you are going to use daylight or flashlight. In choosing your point of view you will find that it will help the picture a lot if you can put some very conspicuous instrument about one third of the way from each edge of the picture (that is to say, so that it would occupy the same position as one of the four heavy dots in Fig. 4). If you are to include yourself in the picture your face should occupy this place.

If you are to use daylight you should also observe that you can see, from the same point of view as your lens, the bright side (not the shadow side) of every instrument, without any instrument being in the shadow of another. If you cannot do this, you had better use a flashlight. Also, if, taking the picture by daylight, you find that you have to include a front view (or even 45° view) of a window, you had again better use a flashlight. In this case it would be better to take the picture *at sundown* than at night, as you will then avoid the peculiar effect caused by black windows, which would mar the photograph.

The next thing after choosing your viewpoint, if you are going to use a flashlight, is to choose the "place for the flash." Here again you should follow the same rule as for daylight, the lens should see the bright side of every instrument of any importance, without its being in the shadow of another instrument.

The exposure is the next thing to consider. If you are going to use daylight you should consult an exposure table, which any photographic dealer will give you free of charge or at very small cost. If you use a flashlight you will find that complete directions about exposure come with the magnesium powder or flash sheet. A very good idea in taking a picture of this

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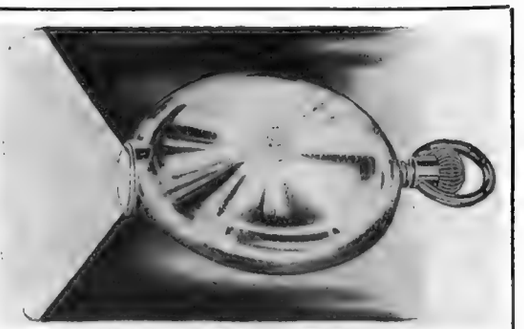

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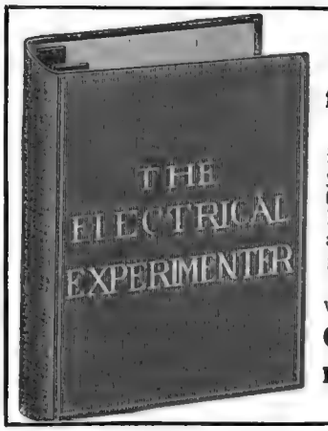

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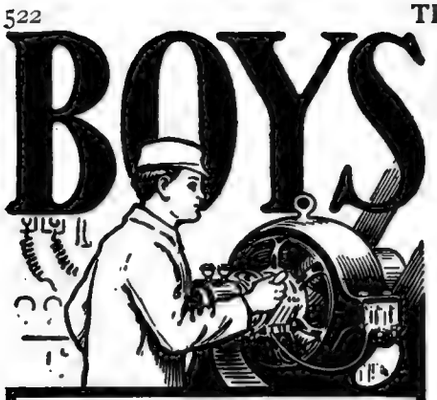

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kind is to expose three negatives, one with the exposure given by your tables or directions; another with one-third of that exposure, and another with three times the exposure. Each of the three negatives should then be developed *separately* (if roll films are used cut them apart). One of them is bound to come out right and give perfect results.

The diaphragm stop used should not be too large, as the instruments at the side of the picture will not be sharp enough. On the other hand, if it is too small, it will considerably lengthen the time of exposure necessary. The best rule to follow is to make it as small as a reasonable time of exposure will permit.

Once the negative is taken the rest, of course, is the same as for ordinary snapshots.

MEASURING THE HEAT FROM DISTANT STARS.

(*Continued from page* 470.)

Using Dr. Coblentz's apparatus at the Lick Observatory, and during the sensitive tests made it was ascertained that the total radiation received from a red star was from two to three times the value of that received from a blue star of the same photometric brightness.

Another interesting problem taken up in this branch of science is the measurement of the radiation from variable stars, especially those which undergo a change of color. The real knowledge, however, will not be gained by measuring the total radiation from stars but by dispersing the starlight and measuring the distribution of energy in its spectrum, and this may be said to be the dream of the experimenter; in other words, the goal toward which he has always turned his efforts. In the near future it is hoped that sufficiently sensitive apparatus of this nature may be constructed which will enable the results aimed at to be achieved. To accomplish this the apparatus must be sufficiently sensitive to measure the radiation of a sperm candle at a distance of more than 500 miles. Dr. Coblentz believes that this can be accomplished without a doubt with some possible changes in the electrical apparatus and also in the reflecting telescope and mirror employed for the purpose.

DOES ELECTRO-MAGNETIC INDUCTION DEPEND UPON LOOPING OR CUTTING OF FLUX.

It was demonstrated by Faraday that when a wire was moved across a magnetic field so as to cut the magnetic flux an electromotive force was induced in the wire during the motion. Faraday also demonstrated that if a loop of wire is linked with magnetic flux any change in the linkage, due either to motion of the loop or to motion of the flux, sets up a temporary electromotive force in the loop. Ever since that time there has been a difference of opinion between electromagneticians as to the manner in which these phenomena should be regarded, says *Electrical World* editorially. Some declared the fundamental law to be that whenever a loop has its flux contents changed in any manner there will be a generation of electromotive force, and the primordial idea is that of a circuit loop. Any cutting of flux by a conductor is therefore a mere case of altering the flux in the loop circuit to which it belongs. Others took the opposite view and contended that a loop is a mere series aggregation of conducting elements, the primordial idea being that of the cutting of flux by some of these elements. It is true that when cutting is effected in this way there will be a change of flux in the circuit, but that is a consequence and not a cause of the electric action. So the loopers and the cutters carried on an animated intellectual warfare, each side declaring that the other side set the cart before the horse. There is a large literature on this peaceful war. In the great mass of engineering dynamo phenomena it was a matter of complete indifference, from a practical point of view, which opinion was held. There was nearly always both a looping action going on, to satisfy the loopers, and also a cutting action going on, to content the cutters. Nevertheless, from an intellectual standpoint, each saw the universe of the other as inside out.

Of recent years, however, the evidence has been accumulating on the side of the cutters. It has been pointed out, for example, that if a loop full of magnetic flux was suddenly injected into a circuit loop, without any flux cutting, and merely by switching at some point of contiguity, no electromotive force was generated in the circuit, and yet flux was being inclosed in a new loop. Blondel recently demonstrated by a series of experiments that when loops are changed in flux contents by tangential motion, as distinguished from motion which cuts, no perceptible electromotive force is generated. This is another blow for the loopers.

Looked at from the standpoint now reached after 70 years of debate, it would appear that no electromotive force can be induced in a circuit unless flux cuts the boundary. "No cuts, no volts," is the day's password. Furthermore, this slogan means, if it is to be trusted, that when a secondary coil lies outside of a primary coil, as, for example, when we apply first a primary and then a secondary winding to a laminated ring core, the flux which traverses the core when the primary winding is energized does not spring up and develop within the primary coil, but comes jumping through the secondary coil from outside, so as to cut the secondary wires. Let us hope that the loopers will finally admit that their loops are cut, and find other fields to occupy their honest and valuable warlike activities.

DR. DE FOREST TELLS OF RADIOPHONE TESTS.

Dr. Lee De Forest, the American wireless engineer, who went to England in September in connection with the trans-Atlantic wireless telephone tests, returned recently from Bordeaux. In an interview regarding trans-Atlantic radio-telephone tests between Arlington and the Eiffel Tower, Dr. De Forest said:

"I was in Paris when for the first time in history words spoken in America were heard across the Atlantic Ocean. I am immensely gratified that it should have been my inventions which first made possible the realization of the prophecy I made seven years ago. At that time I was criticised for announcing that trans-Atlantic wireless telephony would be an accomplished fact within 10 years.

"I found that the French Army officers had been using my audion and amplifier for more than a year, and were particularly pleased at the strength of the telegraph signals they obtain with it from our naval radio station at Darien, Isthmus of Panama.

"The three or four words heard were very faint, but they served at least to accomplish the feat desired by my patent licenses. It marked a genuine epoch. As a matter of fact, it was unnecessary to attempt to use the Eiffel Tower antenna for receiving from Arlington. A connection to some of the network of telephone and telegraph wires to the west of Paris would have answered the purpose."

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 474.*)

The Martian, by long training of his brain for generations back, is enabled to "tune" his mind to a comparative wide range of waves, thus with but little effort he can think in a high "pitch" or in a low one. As each pitch has its own characteristics—no two being alike—it becomes easy for anyone to "listen" to the selected one only. It is the same as if you converse with your friend while ten other people talk all at one time in the same room. By instinct you are enabled to listen to your friend's characteristic voice, disregarding all the other voices. You "tune" your ear automatically to his voice, and while the sounds of the ten other voices reach your ear, you do not *consciously* hear them.

Exactly the same is the case when the Martian converses by thought transmission; his brain "hears" only that what he actually wishes to hear and nothing else. Nor can one Martian force his thoughts upon another if the latter does not want to "listen." He simply shuts the other out, just as you can shut out your friend's voice if you do not care to listen to him. You "tune" his voice out by concentrating real hard on a subject, with the result that you are not conscious of what he is talking about. The same is the case with the Martian.

On the other hand, if the Martian does not want to have anyone "listen" to his thoughts he simply pushes the plates away from his temples, when, of course, no thought transmission can take place.

But, as usual, I get ahead of myself. I believe that I told you last night how we had taken an excursion over the mighty Mars canals with our host, the Planet Ruler, and how we had been shown the machines which move the waters in these miraculous canals. After the inspection our host took us back to the executive palace and once more we were seated in our transparent chairs.

Our host also resumed his transparent chair in front of his desk, which, as I mentioned yesterday, was flat and transparent, while on top 20 transparent Tos rods, curved like goose necks, were mounted in two semi-circles. Our host sitting in front of the desk formed the center of one of the semi-circles, in such a manner that one goose neck was as far away from him as the other.

The august ruler hardly sat down when a 10-foot transparent Tos rod which was mounted on the desk suddenly gave out a pleasant but penetrating chime-like sound. Our host immediately assumed an exceedingly grave manner and quickly motioned to us to pay close attention.

We then witnessed a most astounding procedure.

The ruler of the Planet Mars placed his finger upon a black button-like contrivance in front of him and instantly the transparent goose neck Tos rod in front of the button changed its color and became almost milky white. Simultaneously its upper sharp point began to glow in a bluish white color and a faint discharge, not unlike tobacco smoke, struck our host squarely in the face. This discharge was unlike any electrical high tension phenomenon we had ever witnessed, for it was transparent and it did not make the slightest sound. Moreover it seemed to constantly undergo changes; for a few seconds the stream would be bluish white, quickly to change to a pinkish color during the next moment. Then again it would appear slightly violet. One moment it would spread out, the next it would look like a single beam of light. Altogether it was the most singular, astonishing phenomenon we had ever seen.

But this was not the most wonderful part, for when our eyes were directed upon our host's face another surprise awaited. His expression was continually changing; sometimes he would smile, sometimes he would look very severe. At other times he would nod as if he was giving his approval to something; then again he would sway his head slightly from one side to the other, but at all times while we were watching him we could not rid ourselves of the idea that he was "reading" something.

Indeed, as we were to find out later, this was precisely what he was doing. In other words, we were witnessing how *the Ruler of the Planet Mars was "reading" his morning "correspondence!"*

While we were still marveling the goose neck stopped its dicharge—the ruler had read the first "letters."

We were to see immediately how he answered it. He simply touched a red button in front of the black one, which he had just released, and by his demeanor we did not find it difficult to understand that he was transmitting his thoughts pertaining to the "letter" just received to one of his secretaries. He "dictated" for a few minutes and when he had finished he pressed upon the second black button in front of the second goose neck—he was now "reading" his second letter.

For an hour or more he thus attended to his "correspondence," never slacking, never resting a minute. Whatever the qualities of a Martian ruler are, it is certain that he must be energetic in the utmost, as well as a quick worker. Of course, we had not the slightest inkling of what was going on, but we were to learn the details later.

Briefly they are as follows: The Planet Mars is divided into 10 equal "zones," each administered by a "Zone President." These 10 officials, scattered over the planet at different points, are directly responsible for the welfare of their zone and report to the Planet Ruler once each day at a certain predetermined time.

As the most vital question on Mars is invariably the supply of water, nine-tenths of the Planet Ruler's "correspondence" is on this subject. So strenuous is the battle for existence on Mars that the inhabitants of the planet themselves are always considered after the water supply, never before it. If the Zone President's report has been prepared by him he sits down in front of his desk, similar to the one described, except that it has fewer goose necks than the one of the Ruler. When he presses the red button in front of him his thoughts are immediately transmitted through a cable to the executive capitol and are received by the Planet Ruler. I described a few minutes ago the manner by which the message is received by him. Simultaneously while the Ruler receives his message a record of it is made by one of his secretaries. Connected to the tall Tos rod on the Ruler's desk, which is used to receive the transmitted thought waves, is a sensitive recording mechanism. This latter is in charge of a secretary and works as follows: A thin metallic ribbon of the thickness of tissue paper unrolls slowly in front of a sharp stylus. The thought waves acting upon an amplifying system operate this stylus, which in turn engraves a continuous wave line on the thin metallic ribbon. This wave line is perfectly legible and a Martian can read it as well as you can read an electric ticker tape. Thus incoming as well as outgoing "correspondence" is always recorded, so it can be readily looked up should occasion arise. Each tape is carefully labeled and stored away in the

(*Continued on page 526.*)

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Yachting and **Electrical Experimenter**	3.00	2.45
Youth's Companion and **Electrical Experimenter**	3.80	2.75

TEAR OFF HERE AND MAIL WITH REMITTANCE.

EXPERIMENTER PUBLISHING CO., INC. 233 Fulton St., New York City, N. Y.

Please send the following magazines to the addresses given for which I enclose ..... **as per your special offer in the January, 1916, Electrical Experimenter.** (Write amount you are enclosing.)

(1) ..... (3) ..... (5) .....

(2) ..... (4) ..... (6) .....

Name..... **Street**..... **R. F. D.**..... **City**..... **State**.....

BARON MUNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 523.*)

archives of the capital and, being of metal, it will last practically forever.

But I note by my chronometer that the time is up and in a few seconds the telegraphone wire on my radiotomatic on the moon will be full to capacity. So I must cut off short. *Au revoir*, dear boy, and pleasant dreams till to-morrow.....

A snap, a whirring click and the last ether wave from the moon had reached the earth for that night. I lighted my faithful Nargileh once more and gave myself up to a new series of pipe dreams.

(*To be continued.*)

WIRELESS NOW TO TAHITI.

The radio station being built by the French Government on Tahiti Island, Society Islands, will be ready to receive and transmit commercial messages shortly, the United States Bureau of Navigation announces. Communication will be established with stations at San Francisco, in Cochin-China, South America, Honolulu, Sydney and even in Martinique and Guadaloupe, West Indies.

An electric safety razor sharpener has been developed which its inventor claims will re-edge blades as much as 12 times. The blades are clamped in a holder and inserted between two revolving cylinders. The holder moves backward and forward while the cylinders are revolving, and the blades are edged by even pressure applied to both sides.

CAN HEAR VOICE AROUND, WORLD, SAYS PROF. PUPIN.

Now that the human voice has been heard by wireless telephone across a space one-fifth that around the earth it is commercially practicable to hear it all the way around.

Such is the claim made for the invention of Prof. Michael I. Pupin, of Columbia University, which has overcome the static disturbances caused by electrical storms. He said:

"There is nothing now to prevent the transmission of messages by wireless telephone to every part of the globe. We may talk to the antipodes, or, for that matter, send a message completely around the globe if we like."

This discovery is the result of seven years' experimentation in the engineering laboratory at Columbia. Without going into details which might disclose prematurely his patent claims, Professor Pupin said his device is an improvement over the present form of the wireless antennae and makes the apparatus sensitive only to the particular Hertzian waves desired.

WATER ON MARS.

Dr. Percival Lowell asserts that water vapor exists on the planet Mars. Spectrograms taken by Dr. Silphen indicate a difference in the amount of water vapor at different parts of the planet's surface, and Professor Vary, who has been comparing the spectrograms, is satisfied that the source of the moisture is polar precipitation, the equatorial portions of the planet being very dry. The springtime melting at the North Pole produces a considerable amount of vapor.

ACCEPT THIS BOOK FREE

IT'S INVALUABLE YET CAN'T BE BOUGHT

Just as you will receive it, cloth bound, size 7 x 10¼ ins., 160 pages, 20 lessons, 350 illus., 30 tables, with every bit of information on Wireless you can possibly want, besides valuable information on Electricity, Magnetism and Theory of them **—and it's FREE as explained.**

Will you take a 20 lesson Wireless Course absolutely FREE—even postage charge prepaid?

A course that tells you everything you can possibly want to know about "Wireless" starting off in Lesson No. 1 by explaining the Principles of Electricity. The Second and Third Lessons are devoted to magnetism, motors; generators and wiring. And then, by simple easy stages this wonderful Course takes you into "Wireless." The mysteries of "Wireless" are unfolded to you by the use of such simple language so skillfully used, that of necessity you must understand every word. The subject is not treated superficially, however, for there is a whole lesson devoted to the Theory and Mathematics of this epoch marking subject. To lend charm to the Course, the last Lesson (No. 20) is devoted to a history of Wireless and the men who developed it. The wireless course positively cannot be bought, but will be sent absolutely free with a full year's subscription (12 numbers) of the Electrical Experimenter at $1.00. It's the biggest dollar's worth you can ever buy anywhere at any time. Send for it to-day enclosing $1.00. Send now before you forget. The coupon below is a convenient way. But do it now.

THE EXPERIMENTER PUB. CO., Inc.
Publisher
"The Electrical Experimenter Magazine."

EXPERIMENTER PUB. CO., 233 Fulton St., New York

Gentlemen:

On your absolute guarantee that your 20 Lesson Wireless Course is just as described by you, you may send me same *FREE*. You are to send me this Course at once, all charges paid, and enter my name for a full year's subscription to the *Electrical Experimenter*, 12 numbers, for which I enclose *$1.00, the price of the Electrical Experimenter alone.

(If a 2-year subscription is desired, enclose $1.85.)

My name is.....

My address is.....

(12) *Canada and Foreign Countries, $1.50—2 years, $2.85.

With the "Ad-Man"

WAR orders in every industry we hear are bringing millions of dollars to American factories and American pockets. Prosperity we know is here and apparently here to stay. But—what, say you, have these war orders to do with the electrical experimenter—he is not profiting by them.

He is, and, feeling that he doesn't really appreciate how little he is affected, yet how often he is prone to complain of his lot, I must explain a few things to him and tell him why I think he is lucky.

Firstly: How many articles does the electrical experimenter use that haven't increased in price and often increased heavily as a result of the enormous demands of the whole world for our products, or because they are imported?

Offhand, I can't think of one, so you will probably suggest wood. Even that has gone up slightly, and surely finished wood *has* gone up, following increases in cost of varnishes, shellacs, resins, etc. Yet, the electrical experimenter pays practically the same prices for goods as he did before the war started and in many cases less (with the possible exception of a few sizes and styles of batteries). Of course, it's a natural question for you to ask, if brass, zinc, copper, rubber, everything has gone up in cost, why doesn't the electrical experimenter pay more for his goods. Simply because he buys most of his supplies from reputable concerns that have catalogs widely distributed which contain fixed prices, and they simply have to take that increased cost off their profit, and all too often take a loss rather than raise their prices.

And the manufacturers and supply houses besides increased prices have other troubles, for even at increased prices they cannot get prompt delivery or even reasonable delivery on raw and manufactured materials. I understand that the largest aluminum manufacturer is only taking orders for delivery *eight months later*, while one of the biggest steel companies *won't take an order at all*, and similar conditions exist in the copper, brass, zinc and many other industries. Therefore, friend experimenter, when delivery from a supply house is a bit slower than in the past, try to have a little patience; remember the other fellow's troubles these days that he doesn't pass on to you or tell you about, and be thankful for your lot even tho it may seem a bit hard.

MILTON HYMES.

A recent proclamation of the Governor General of Australia prohibits the importation of electric or magnetic belts.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The **Very** people, the **Only** people, who could possibly have a use for your things read this journal. More than 40,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: One cent per word (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. **Remittance must accompany all orders.**

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the February issue should reach us not later than January 5th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

BARGAIN—3-amp. "Amco" hot wire ammeter, 5 inches diameter; slightly used; cost $6. Will sell for $3.50. Eugene Hartnell, Salem, Wis.

FOR TRADE—12 numbers of "World's Advance" Dec. 1914-1915. Want book of "Experimental Wireless Stations" or Electro's universal detector. Forrest Monroe, 1153 Te Walt, Vincennes, Ind.

BARGAIN!! First remittance of $9.50 takes transformer coil with vibrator (½ K.W.) electrolytic interrupter, electrolytic detector and large transmitting condenser. All in good condition. Raymond Guy, Tottenville, S. I., N. Y.

FOR SALE OR EXCHANGE—Modern Electrics, June 1909 to June 1914; Popular Electricity, Dec. 1909 to Nov. 1914; Elect. & Mechanic, Feb. 1910 to Jan. 1912; Wireless Age, first 18 numbers; all inclusive. What have you to "swap"? Leon Bryant, Camden, Me.

HAVE four ½ coils, $1.50 each, Marvel carburetor. Harold Barnum, Knowlesville, N. Y.

WANTED — Small sending and receiving set for $5 gas moving picture machine, generator and film. List of things for stamp. D. MacLean, 334 Stevens, Lowell, Mass.

SWAP—Year 1915 "Telephone Engineer" magazine, value $2, fine condition, for year 1914 "Electrical Experimenter" or good key, or one good 1,000 ohm 'phone; also good telephone magneto for detector, camera for 'phones, dandy 12-inch 3-speed D. C. fan for 'phones, or consider good boxing-gloves bargains. Have large A. C. ammeter for offers; also want audion bulb, "Detectiphone" transmitter, or what? Everybody answered if you write quick. Lloyd Smith, 468 Oak St., Ashland, Ore.

EDISON standard phonograph, New York projecting lantern; each cost $25. Exchange for typewriter, etc. Tillinghast, 63 Wendell St., Providence, R. I.

FOR SALE—Electro $4.50 phones, $2.75; oscillation transformer, $2; high-tension air-cooled spark gap, $1.50. Instruments in excellent condition. Stuart W. Pierson, Carrollton, Ill.

$6 takes induction coupler in hard rubber cabinet, coupling and turns varied by knobs. Want two 43-plate variables. Francis Pray, 102 Heath St., Somerville, Mass.

FOR SALE—Double slide tuner, $1.25; galena detector $.50; Junior fixed condenser, $.40. Whole set, $2. Raymond Horney, Centreville, Md.

FOR SALE—Six telephone magneto generators in good condition, at 75c. each. Can be used as shocking machines, etc. Write Box 360. Lancaster, Pa.

FOR EXCHANGE—Moving picture machine, run by motor. Machine and reels cost $17. In good condition. Will exchange for two 6-volt 60-amp.-hr. storage batteries. Wm. Combs, Water St., Troy, O.

WANTED—A drum. Have all kinds of athletic goods, $50 stamp collection. Write for list. Larest Elwell, 539 Mercantile Bldg., Rochester, N. Y.

FOR SALE OR EXCHANGE—Marconi magnetic detector, cost $10; fixed condenser, receiver ear cushions, ¼-inch spark coil, potentiometer, electrolytic and silicon detectors, mill-ammeter, folding Brownie No. 2 camera. Want variable, or offers. Frank Bremer, 3613 Boulevard, Jersey City, N. J.

NOTICE—110-volt A. C. fan, new condition, $3; 6-volt 10-lb. motor, $2.50; 75-ohm receiver and cord, $.35; Ajax motor, $.50. Sell or exchange for anything of equal value. Electrical, wireless, X-rays, camera, musical, etc. Francis H. Ransford, Dalton, Mass.

FOR EXCHANGE—$15 post card projector, 4x10 Panoram camera, 3x5 Kelsey printing press, $32 B. & L. micro-tessar lens, 72 mm., for 5x8 printing press, binocular or field glass. J. F. Goering, Ames, Kan.

FOR EXCHANGE—Complete wireless outfit, cost $9.25; No. 3 Brownie with portrait attachment, $4.50; Ferron detector, $5; Mesco wireless key, $1.65; Eveready detector, $1.75; fixed condenser, small telescope, spark gap and four-tip cord, $2.60; electrical magazines, $3.50. Everything in fine condition. Want audion, crystaloi, variables, or what? Benj. F. Kinnick, Jr., Greenwood, Ind.

FOR SALE—2x2-inch gasoline engine; has new piston, cylinder, coil and carburetor. The first $15 takes it. Fisher Ames, Massena Springs, N. Y.

FOR SALE OR EXCHANGE—Corbin Duplex coaster brake, $2; carbide bicycle lamp, 75c.; electric bicycle light, $1; boxing gloves, $1.25; waterproof hunting coat, $3; Eastman 3½-inch film developing tank, $3.50. Will exchange for Gernsback rotary variable condenser, interrupter, ½ K. W. transformer coil, or what have you? All letters answered. R. St. John, 609 St. John St., Fairmont, Minn.

FOR SALE—One-inch transmitting set, loose coupled receiving set, including aerial wire, electrose insulators, 100-ampere lightning switch; also 1-7 H. P. motor, medical coil, Brownie 2A camera, tools, etc. Sell to first reasonable offer; all answered. Arthur Reider, 456 E. 10th St., New York City.

HAVE type AA crystaloi. Want good audion bulb or will pay cash for one good or burnt-out. M. Burberry, 627 Germania St., Columbus, O.

RESULTS!

Rosser, Man.

Please make 3 more insertions of my ad. as per enclosed clipping. **Results have more than exceeded my expectations.**

(Signed) J. L. GREEN.

THERE'S A REASON.

WILL SELL good 25-cal. Stevens single-shot rifle for $2.50 or exchange for good 22-cal. single-shot rifle. Ingwald Wick, Hendrum, Minn.

FOR SALE—1½-inch coil, used a short time, for $2.75; also an 80-watt magneto generator for $4.25. Dominick Frank, 111 E. Walnut St., Indianapolis, Ind.

PAIR of steel skates, No. 9½, in good condition. Want pint Leyden jar. Donald Whittier, Readfield Depot, Me.

HAVE good magic lantern and four dozen slides. Will exchange for wireless supplies. Donald Whittier, Readfield Depot, Me.

INGENTO enlarging lantern, cost $55; also set Sheldon salesmanship text books, cost $65. Want printing press and outfit, or what? Daniel Goff, 3159 Indiana Ave., Chicago, Ill.

FOR SALE—Pocket wireless outfit, size of watch. Write for particulars immediately. T. H. Moore, Jr., 321 N. Spring St., Pensacola, Fla.

WILL SELL oak cabinet receiving set, loose coupler (with primary switch) variable condenser, crystal detector, fixed condenser, peroxide of lead detector (new), with new potentiometer and battery, only $10.35; large D. P. S. T. switch on slate base, 55c.; Ajax motor, 90c.; buzzer, 45c. Want burnt or broken audion bulb. Roy Keddy, 35 Josephine Ave., Somerville, Mass.

WANTED—Air guns and rifles. Have football, two cameras, stamp collection $20, electrical and athletic goods. Larrest Elwell, 539 Mercantile Bldg., Rochester, N. Y.

FOR SALE—Wireless instruments, complete receiving set; also key, spark gap and sending condenser. Cheap. Write Walter J. Schneider, R. R. No. 2, Hamilton, O.

FOR SALE OR EXCHANGE—A. C. motor, $2; galvanometer, 75c.; tuning coil, $1.50; ¾-inch spark coil, $1.50; chemistry scale, $1. Write Albert Heyman, 227 S. 20th Ave., Minneapolis, Minn.

WANTED—Camping and bicycle materials for wireless apparatus, or will sell. Arthur Sacha, 2669 E. 40th St., Cleveland, O.

FOR SALE—Cornet, fife, books and some cowboy and wireless goods. Send for list of articles. Frank Saunders, Richmond, Me.

FOR SALE OR EXCHANGE—Nearly new 4 H. P. Indian cycle motor, with carburetor, muffler, friction clutch, pulley and Bosch magneto. Condition perfect, used three months, $30 C. O. D. W. J. Wilson, 2613 Binney St., Omaha, Neb.

FOR SALE OR EXCHANGE—Complete E. I. Co. Tesla coil, including 2-inch spark coil, gap, condensers, Geissler tubes, cost $20; $35 course in elocution, course in hypnotism, how to enter vaudeville, and electrical books. What have you? All letters answered. William Morris, 130 Elizabeth St., Moberly, Mo.

WILL PAY cash for used or burnt-out audion bulb. Four thousand feet of motion picture film given if desired, or iron scroll work machine, cost new $8. Harry Smejkal, 1349 First Ave., New York City.

WANTED—To buy telephone desk set, any standard make, first-class condition, without ringer. Also want separate long-distance telephone transmitter. Donald Palmeter, Roundup, Mont.

WANTED—Constant speed spring motor that will run at least 30 minutes, power stronger than phonograph motor; also unused audion bulb. Fair prices will be paid for these articles if in good condition. William H. Trippe, Toms River, N. J.

EXCHANGE—New radioson detector as part payment on R. J. 4 audion in perfect condition, or will buy. Write Carl A. Mathiasen, Onawa, Ia.

FOR SALE OR EXCHANGE—One ohm-meter for measuring resistance; has range one-tenth to one hundred thousand ohms. Just the thing for wireless experimenters. Cost $30. Will make a good swap. Also two fan motors—A. C.—two volt ammeters for storage batteries. Want a good barometer, hygrometer, or what have you? H. H. Peebles, 1371 Westlake Ave., Cleveland, O.

EXCHANGE—Premoette Jr. No. 1, with outfit. Want small dynamo-motor. Also want water motor cheap for cash. Charles Clapp, Uphams Corners, Mass.

FOR SALE—Complete wireless outfit, mounted and connected on base. Receives Arlington, Va., and Sayville. Sends 10 miles, $30. Send stamp for details. Make fine Xmas present. Charles Palmer, 57 Wollaston Ave., Arlington Hts., Mass.

FOR SALE—Indian twin, '14 model, in fine running condition. Will sell for $125. Louis Germains, 257 Pleasant St., Worcester, Mass.

MERKEL single motorcycle to exchange for long-distance receiving set and small sending set, complete with aerial, or will sell for $19 cash. C. D. Wright, Hamburg, Ia.

FOR SALE OR EXCHANGE—Moving picture machine with oil lamp, film, slides, cost $4, sell for $2. One thousand shot air rifle, cost $1.50, sell for $1, with shot, carrying cover. All in perfect condition. What have you electrical? E. Feddersen, 235 W. 12th St., New York.

FOR SALE—Receiving set, cabinet type, combining receiving transformer, audion detector etc.; also audion amplifier. Other apparatus. Particulars on request. J. A. Crowdus, 5047 Washington Ave., St. Louis, Mo.

WILL EXCHANGE a good motorcycle in first-class running order, free engine clutch, fully equipped, for a four-cylinder gasoline engine in good running condition. R. A. Peschman, Box 3, Ft. Sheridan, Ill.

MOTOR BARGAIN—Kimble ⅛ H. P., 110-volt A. C., six speeds, just rewound and in good condition, $15. Might trade. Ross Gunn, 369 W. Lorain St., Oberlin, O.

FOR SALE—A Baker electric coupe in first-class condition with new batteries; three passenger. On account of illness of owner, will sell at bargain price of $500; cost new, $3,200. S. Gernsback, 817 West End Ave., New York City.

AMATEURS, LOOK—A complete sending and receiving set for sale. All instruments in very good condition, and will fully guarantee them. Will be sold by the piece or complete set. Write before it is too late. Roy Wienn, 522 Wabash St., Michigan City, Ind.

WE HAVE many things to exchange. What have you? Write for list. J. M. Willoughby & Co., Ahoskie, N. C.

FOR SALE—Elec. inst. and books. Write for price list. E. W. Sanor, 198 15th St., Milwaukee, Wis.

I WILL dispose of all my wireless instruments very reasonably. Send for photo and information. E. B. Nassinheimer, 145 W. Fourth St., Cincinnati, O.

FOR SALE—New E. I. Co. $7.50 loose coupler, $5 cash. Freddie Silsbe, Prattsburgh, N. Y.

FOR SALE OR EXCHANGE—Edison phonograph, Model A, combination type, for $10; cost $25.75. Also 22-caliber rifle, Stephen's Favorite, $3; or exchange for nickel-plating outfit. Address Earle Cochran, Poplar Bluffs, Mo., Route 2.

WILL EXCHANGE post card projector, worth $5, for variable condenser—either Gernsback, Murdock, Blitzen or Amco. Address Max Clinch, Lakewood, N. J.

WANTED to exchange photo cameras and goods for wireless set; also want dynamo and gas engine. A. B. Warfel, Photographer, Cadiz, O.

FOR SALE—I. C. S. Reference Library Electric Lighting and Railway Course, five volumes, complete, A1 condition. Robert Onstott, care Y. M. Sing, R. 1, Sheldon, Ia.

WILL EXCHANGE 3-inch spark coil for $6 type crystaloi detector. Those interested write. Will Gasper, N. Third St., Marquette, Mich.

FOR SALE—One type AA crystaloi detector, roller and ice skates, two baseball gloves, fish pole, Popular Mechanics (30 old ones), boys' books, Baldwin camp lamp and carbide. Wanted, old, broken or new audion bulbs. Will exchange bulbs for equal value of articles for sale. Write for prices. George Auten, Oberlin, O.

TWO complete sets of wireless receiving instruments sell at half price. For particulars write to Fred Carlotte, 80 Charles St., New York City.

DE FOREST audion detector type R. J. 4 (with X grade bulb), $12. Write for particulars. Francis Blewer, Newark Valley, N. Y.

STOP! Have navy type transformer (switch points), imitation rubber, rotary variable condenser, drafting inst. (12 piece) and 110-volt A. C. motor, 1/6 H.P. Want Crystaloi, electro loading and a single shot 22 rifle. W. O. Fitchett, Waverly, Va.

Carrollton, Illinois,
Nov. 25th, 1915.

Dear Sirs:

I put an ad. in the Scientific Exchange Columns recently, having five instruments for sale. I sold every one of them. ADS IN THESE COLUMNS CERTAINLY BRING RESULTS.

Yours truly,
S. W. Pierson.

FOR SALE—Storage battery plates, six pairs 3¼x5, new. O. Brinnel, 523 First Ave., New York.

FOR SALE—Brand new Murdock 2,400 ohm headset, never used, $4.50; new brass key, ½-inch contacts, $2; smaller key, 50c.; small gap, 40c.; coronet headband, 35c. Clinton Stanley, 153 Mariner St., Buffalo, N. Y.

SALE OR TRADE—1 Murdock rotary gap, 1 1/10 gap motor, 1 navy type loose coupler, $23 kind, will take $13; 4 variable condensers, 3 pr. 'phones, 1 Blitzen 1 K.W. transformer, 1 aerial switch, detectors, insulators, wire 1 motor generator 6-6, 1 jeweler's lathe used 3 months, worth $15, will sell for $9; 1 1-inch spark coil, 1 pr. aluminum roller skates, kodak, and complete outfit; $10 commercial key, new, for $6. All letters answered. Don I. Shepherd, 316 N. West, St. John, Kan.

FOR SALE—Complete portable wireless sets, 2-inch spark coil, sending condenser, spark gap, key, battery and aerial switches, loose coupler, rotary and variable fixed condensers, mineral detectors, loose coil; sacrifice, $25. Fifty ohms learners' set, with battery, $1.50; combination safe, $3; medical coil, 75c. A. Sterling, 78 Third Ave., Brooklyn, N. Y.

FOR SALE—Loose coupler, $1.25; Gem receiving set, $1.25; both Nichols make. In good condition; nearly new. William F. McCarter, 4718 N. Camac St., Philadelphia, Pa.

WANT good 2-inch coil, cheap. For sale, 1-inch Manhattan coil and other wireless goods. Write William F. McCarter, 4718 N. Camac St., Philadelphia, Pa.

WANTED—Wireless goods, battery motor, electrical books, magazines. Have $30 bicycle, 4x5 Seneca camera, 20-ohm sounder, pole climbers. All communications answered. Greer Peck, Springfield, Tenn.

HAVE E. I. Co Junior loose coupler, potentiometer, fixed condenser, electrolytic detector with 2-inch wire. Value of all $8; sell $5. Paul Ramsdell, Calais, Me.

FOR SALE—Navy type loose coupler, 6,000 meter—30 inches long—with dead-end switch, $9; 1 K. W. transformer, unmounted, $9; ¼ K. W. transformer, unmounted, $5. Paul Flehr, Ironton, O.

FOR SALE OR EXCHANGE—Brownie No. 2 camera, $1; detector, 25c.; $2 tuning coil, $1; or will exchange for a ½-inch spark coil. Henry Ananiantz, 700 W. Washington, Los Angeles, Cal.

FOR SALE AT A BARGAIN—A Meccano outfit No. 5 for $9, cost $18. I will trade for some wireless apparatus. Particular sending. Would prefer someone in my own city. Write and get particulars. Alfred Emmerton, 2242 Polk St., San Francisco, Cal.

FOR EXCHANGE—Good $10 Eastman folding Kodak, good as new, for good head phones or good loose coupler. What have you? Dean Wight, Lamoni, Ia.

FOR EXCHANGE—One Gasoline engine, 3 horsepower, A1 condition, for wireless receiving instruments; make me an offer. A. Rush, 323 Traymore Ave., Pittsburgh, Pa.

AUDION detector and 2-step amplifier combination. Best cash offer takes it. Be quick and write for particulars. This is the chance of your life. Have ½ K.W. transmitter at same terms. Louis Gebhard, 1127 Ellicott St., Buffalo, N. Y.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the February issue should reach us not later than January 5th.

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

BOOKS

HAVE YOU SEEN A COPY? Amateur Photographer's Weekly, $1 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription, 25c. Amateur Photographer's Weekly, 915 Schofield Bldg., Cleveland, O.

FORMULAS

FORMULAS — Artificial gold, perfume, candies, inks, and 200 others; 3 for 25c. L. Gilbert, Bristol, N. Y.

25c. BRINGS 30 guaranteed formulas, with complete instructions. Includes silvering mirrors, champagne cider, artificial coal, China cement, etc. Daley-Meyer, 688 President St., Brooklyn, N. Y.

HELP WANTED

BOYS WANTED—To buy full-sized paper patterns for Go-Devil bob sled (latest out). Price 30c., prepaid. A. Seaver, Grand Rapids, Mich.

DRAWINGS made for inventors. Consulting Engineer, EE-3240 Seminary Ave., Chicago.

YOUR IDEAS may bring you wealth, if patented through credit system. Send sketch. Free search. Book free. Waters & Co., 4287 Warder Bldg., Washington, D. C.

MISCELLANEOUS

FILMS developed free. Send negative for sample print and particulars. New Lex Novelty Co., New Lexington, O.

THERE is but one Telegraph School that places all graduates direct in the railway telegraph service. It is Pelnars, Madison, Wis.

PATENT ATTORNEYS

PATENTS SECURED through credit system. Free search. Send sketch. Book and advice free. Waters & Co., 4287 Warder Bldg., Washington, D. C.

IDEAS WANTED—Manufacturers are writing for patents procured through me. Three books which list hundreds of inventions wanted sent free. I help you market your invention. Advice free. R. B. Owen, 130 Owen Bldg., Washington, D. C.

PATENTS without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

PATENTS SECURED or fee returned. Send sketch or model for free search and report. Latest complete patent book free. George P. Kimmel, 254 Barrister Bldg., Washington, D. C.

STAMPS AND COINS

STAMPS—100, all different, free. Postage, 2c. Mention paper. Quaker Stamp Co., Toledo, O.

$2 to $500 EACH paid for hundreds of coins dated before 1910. Send 10c. for our New Illustrated Coin Value Book, 4x7. Showing guaranteed prices. Get posted at once. Clarke Coin Co., Box 14, Le Roy, N. Y.

WIRELESS

SILICON, 10c. ounce; 35c. half pound, postpaid. Lloyd Gress, Pitman, N. J.

SELLING OUT—Our entire stock of $8 loose couplers at $4.25. One of these same instruments in test received 1,600 miles. Manuel Rattner & Bro., main office, 36-38 Union St., Poughkeepsie, N. Y.

RADIO queries answered fully and promptly; 3 for 10c.; 8 for 25c.. J. L. Green, Radio Information Bureau, Rosser, Man.

GALENA Detector No. 35, on fiber base, 35c.; parts, 25c.; postage either, 5c. Cat whiskers, 3 for 5c.; 12 for 15c., mailed. W. Patch Co., Klemme, Ia.

WIRELESS—Bargains in new wireless goods, circulars for stamp. Imperial Electric Co., 80 Wallabout St., Brooklyn, N. Y.

$10 COMMERCIAL Keys for $4. Money refunded if not satisfied. Massie Wireless Telegraph Co., 77 Washington St., Providence, R. I.

2,500-METER loose couplers, $5; other wireless bargains. Send for circulars. Cliff Mfg. Co., Brookfield, Mass.

WITH REGULAR BAND

Complete Double Set

2000 Ohms - - $4.00
3000 Ohms - - 5.00

With Coronet Band
$ .50 additional

WITH CORONET BAND

WHAT YOU SAVE

on these remarkably good 'phones will buy other Murdock apparatus for your station. REMEMBER, these low prices do not mean cheapness in the goods. These No. 55 receivers are real wireless 'phones, with pure copper wire coil windings—with resistance guaranteed. They are far superior to any you may obtain elsewhere—in sensitiveness, in materials, in construction. They bring in the signals from far and near with the sensitive precision of more expensive instruments. They work well, look well, and wear well.

MAKE A TEST YOURSELF

We will, upon receipt of price, forward the set desired for fourteen days' trial. If they are unsatisfactory in any way, they may be returned and your money will be refunded immediately.

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Flashlight, 60c.
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We set the standard in complete receiving and transmitting outfits. Don't buy until you see our Catalog.

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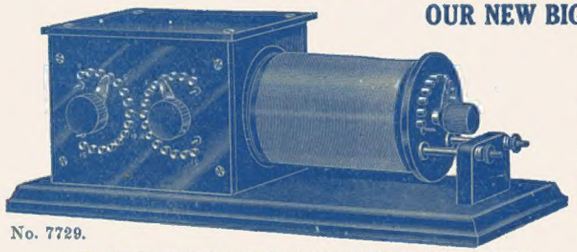

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Represents the latest advances made towards the ideal tuner and embodies the greatest degree of perfection yet obtained. No greater value can be secured where accurate selectivity, sensitiveness and finish are desirable. The illustration shown herewith cannot possibly do justice to the instrument itself. The primary winding is enclosed in a cabinet, the sides and top of which are polished hard rubber. Two 15-point switches are mounted on the front. One switch controls the primary in groups of several turns and the other controls one turn at a time. The entire variation of the primary is thus secured by the rotary motion of two knurled knobs rather than the movement of a slider, and may be varied from 1 to 225 turns in steps of one turn at a time. The windings are especially adapted to long wave lengths. The secondary is wound with green silk covered wire. The ends are HARD RUBBER, turned and polished. Secondary variation is secured by a 12-point switch which makes it possible to secure a very fine adjustment. **PRICE, ONLY $15.00**

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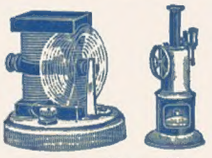

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Our Catalog shows 25 more.

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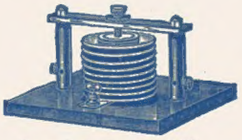
Amco Spark Coils are acknowledged the best.

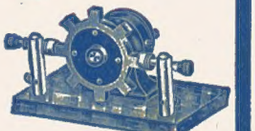
Light Outfit, 75c.
Several hundred miniature lamps, sockets, etc., are illustrated in our Catalog.



Quenched Gap, $15.00.

Fun With Magnetism.

Fun With Electricity, 50c.



Rotary Gap, $12.00.

Christmas Gift Suggestions

ELECTRIC LIGHTING OUTFITS FOR CHRISTMAS TREES

For the Christmas tree, the house party table, and at all other night-time gatherings—either indoors or out—our lighting sets may be tastefully worked into the decorations. They are safe, easily installed and will last for years.

We especially recommend these outfits for Christmas tree lighting as shown in our illustrations. There is hardly a thing that is more welcomed by the little ones as well as grown-ups than an electric lighted-up Christmas tree. People who have never seen these outfits in actual use cannot appreciate the beauty that can be obtained by colored electric lights. The wiring as well as the sockets that hold the lamps are in green to match the color of the tree itself, and for that reason only the lights themselves show up to their full advantage.

Any one even with no experience at all can place these lights on the tree and it is of course self-understood that the larger the tree the more lights should be used.

BATTERY OUTFITS

In localities or houses which do not have lighting current we recommend our battery outfits which work from 15 to 20 hours figuring 3 hours' steady use each day. Of course if the current is turned on for a shorter period of time the batteries will last much longer.

BATTERY OUTFIT PRICES

No. 5700 Electric Tree lighting outfit, with 8 lights and 3 batteries. Size of box without batteries 6¾x5¾x2 ins. Shipping weight 12 lbs. **$2.35**

No. 5701 The same outfit without batteries. Shipping weight 2 lbs **$1.85**

No. 5702 Electric Tree lighting outfit with 8 lights and 6 batteries. Size of box without batteries 6¾x5¾x2 ins. Shipping weight 20 lbs. **$2.80**

No. 5703 Electric Tree lighting outfit with 16 lights, 6 batteries. Shipping weight 25 lbs. **$4.40**

No. 5704 The same outfit without batteries. Size of box without batteries 6¾x5¾x2 ins. Shipping weight 3 lbs. **$3.60**

110 VOLT LIGHTING OUTFITS

These outfits do not use any batteries but each festoon is equipped with patent attachment plug which screws into any 110 volt electric light socket. There is no danger to this outfit either from fire or from shock. These outfits have all been approved by the National Board of Fire Underwriters.

The lamps themselves have an average life of 800 hours. The lamps are quite powerful, having 14 volts and will give a strong light, even 1 festoon will light up a small tree quite brilliantly.

Each outfit has an assortment of the following colored lamps: Red, green, blue, frosted, clear.

LIGHTING CURRENT OUTFIT PRICES

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Size 10x4½x2½ inches. Shipping weight 2 lbs.

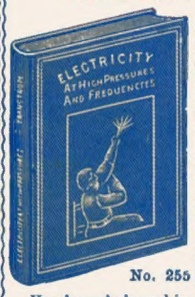
No. 5707 2 festoon, 16 lamps 14 volts. **$4.05**
Size 13½x5½x2½ inches. Shipping weight 3 lbs.

No. 5708 3 festoon, 24 lamps 14 volts. **$5.85**
Size 14x6⅝x3 inches. Shipping weight 4 lbs.

No. 5709 4 festoon, 32 lamps 14 volts. **$6.90**
Size 15x8x3 inches. Shipping weight 5 lbs.

NOTE.—These outfits work on either direct or alternating current. If they are to be worked with 220 volts, get our special prices on resistance and state how many festoons you wish to use.

No. 255. ELECTRICITY AT HIGH PRESSURES AND FREQUENCIES



No. 255

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